FACING AMERICA'S TRASH:
WHAT NEXT FOR MUNICIPAL SOLID WASTE?

Interim Summary

June 1989

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The final assessment will be available late summer of 1989.

Congress of the United States Office of Technology Assessment
Oceans and Environment Program

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OVERVIEW

"Waste not, want not"—a notion that helped carve a Nation out of a wilderness, but increasingly a discarded concept. It is time to revisit this notion, reassess our attitudes about MSW, and plan a wise policy to guide the Nation into the next century.

Today we find ourselves facing growing mounds of trash and the label "throw-away society." Is it true? In the United States, we generate over 160 million tons of municipal solid waste (MSW) each year—more than one-half ton per person—and the amount is rising steadily (box A; figure 1 shows the estimated portions of materials and products in MSW, by weight). In 1986, only about 10 percent of all MSW was recycled and 10 percent was incinerated (mostly with energy recovery), while 80 percent—about 130 million tons—was disposed of in landfills (figure 2). Although landfilling has been the most available disposal method, the number of permitted landfills is declining and landfill costs are rising in many parts of the country. Recycling and incineration both can be increased, although they cannot totally eliminate our dependence on landfills.

Many areas of the country are experiencing shortfalls of permitted landfill capacity. The Environmental Protection Agency (EPA) estimates that 80 percent of existing permitted landfills will close within 20 years (figure 3).[1] Landfill capacity is declining primarily because of the concurrence of three interrelated trends: 1) older landfills are reaching the end of their expected lives; 2) environmental requirements are being strengthened by some States and local governments (which has resulted in the closure of substandard landfills, but which also can ensure that future landfills will be more environmentally sound); and 3) siting new landfills is difficult, in part due to public opposition.[2] This opposition results primarily from previous experiences with poorly performing facilities, concerns over potential health and environmental risks, "Not In My Backyard" (NIMBY) attitudes, and the failure of public officials to involve the public adequately at the beginning of the decisionmaking process.

In areas where landfill capacity is declining or exhausted, and where other management capacity such as recycling and incineration cannot be increased sufficiently in the short term, one of the options being pursued is to transport MSW to other jurisdictions within a State or to other States. Localities receiving these transported wastes express concern about additional risks to human health and the environment and the strain on their own MSW management capacity. Yet their legal leverage to restrict such shipments is limited.

The costs of MSW management are rising steeply, driven in part by these factors. Per person MSW costs are still relatively low, but the rate of increase already is causing financial problems for some communities. Further, as proper management of MSW becomes more expensive, the likelihood of illegal disposal will increase.

The regional and national implications of these problems are becoming evident, yet the Nation lacks a clearly articulated Federal policy for MSW. Consequently, State and local authorities receive little guidance to help them address their MSW problems. Although primary responsibility for MSW management rests with State and local governments, the Federal Government can help in two areas: first, by addressing some immediate problems and second, by addressing

[1]This estimate was made before EPA proposed its new landfill guidelines, which could further increase the number of closures. As the revised guidelines are now written, if existing landfills close within 2-1/2 years of their adoption, the landfill owner will be exempt from costly requirements for closing and cleaning up the facility. Substandard landfills are likely to close to avoid these costs.

[2]Siting is not only a problem for landfills, but also for other MSW management facilities, such as incinerators and recycling facilities.

the longer-term issue of how society uses and disposes of materials and products.[3]

The Federal Government could help address the most pressing problems by:

- resolving the uncertainty created by unfinished Federal guidelines on landfills and incinerators;
- addressing issues associated with increased interstate shipments of MSW; and
- providing better information about technical capabilities, comparative costs, and risks of different MSW management methods.

One immediate action that EPA could take to accomplish these goals, possibly with additional congressional guidance, would be to complete regulations for all MSW management methods. This would involve finishing the revision of the landfill regulations, adopting regulations for MSW incinerators, and developing regulations for composting and recycling facilities (some of which currently are unregulated at the Federal level). These actions would reduce uncertainties regarding requirements for new facilities and could help better protect human health and the environment. If increased Federal regulation of MSW management is to occur, it should be accompanied by strengthened Federal enforcement provisions. States would also need to increase enforcement action against improper disposal.

Congress could also address the issue of ensuring sufficient management capacity for MSW. For example, Congress could require each State to guarantee management capacity for a specified percentage of MSW generated within its borders—a "capacity assurance" provision.[4] Even with such congressional action, States and localities still may have problems siting the facilities needed to meet their capacity requirements. To address this problem, EPA could develop model siting and dispute resolution procedures. These procedures could suggest how a State authority, through binding arbitration or other methods, could resolve siting disputes that cannot otherwise be settled at the local level.

In addition to addressing these immediate problems, the broader issue of how the Nation uses materials—from manufacturing through subsequent distribution and disposal—should be considered. *A clear national policy on MSW that addresses the use of materials is essential for providing a broader context in which specific MSW programs can be developed and implemented. Waste prevention and materials management should be the foundation of this policy* (see figure 4).[5]

It is important to make a clear distinction between *prevention* and *management* activities to ensure that adequate attention is focused on each.[6] Prevention refers to activities by manufacturers (e.g., modifying products, including packaging) and consumers (e.g., modifying purchasing decisions) that reduce the toxicity or quantity of products *before* they are purchased.[7] The motivation for promoting MSW prevention

[3]Although it is beyond the scope of this report, it should be noted that the way in which we use our resources and materials has important implications not only for MSW, but also for other environmental issues such as global warming, natural resource conservation, and pollution abatement.

[4]A capacity assurance provision, for example, is included in both the Comprehensive Environmental Response, Compensation, and Liability Act and the Low-Level Radioactive Waste Policy Amendments Act. Implementing such a provision for MSW, however, would differ.

[5]The materials management approach builds on materials use concepts that have been discussed for many years (e.g., Ayers and Kneese, 1969; Kneese and Bower, 1979; OTA, 1979). In fact, many communities practiced a form of materials management prior to the 1960s, when they routinely separated discarded materials for management. Only in recent decades have most communities collected mixed MSW, a trend that was encouraged by, for example, the advent of collection trucks that compact MSW.

[6]This differs from the concept of "integrated waste management" espoused by EPA and others, because that concept includes prevention within a hierarchy of management options.

[7]Product modification also has implications for the management of products discarded as MSW (e.g., the recyclability of a product). It should also be noted that OTA includes backyard composting of yard and food wastes as a form of quantity reduction because no public or private sector management is involved.

is strong and simple. Reducing toxicity would make all management methods safer and could restore public confidence in waste management policies and programs. For example, reducing the amounts and types of organic chemicals in landfills would mean less air pollution (e.g., from volatile organic chemicals) and less toxic leachate. Quantity reduction would mean that, at some point, the overall capacity for managing MSW would not have to increase, which in turn could lead to a decline or stabilization in the costs of MSW management.

OTA cannot predict the extent to which waste prevention will occur, but this approach offers important potential benefits that are worth pursuing. If Congress includes prevention as part of its national policy for MSW, there is widespread consensus that a vigorous Federal role will be needed to pursue these opportunities. This is in part because the Federal Government has the potential to affect products and materials that move across State boundaries. In addition, one important consequence of a national MSW prevention policy would be that the government would become responsible for leadership in putting the policy into practice. To date, MSW prevention has received little congressional attention and EPA has not had the resources or political motivation to promote it.[8]

Even assuming notable progress in waste prevention, communities will continue to generate large amounts of MSW requiring management. In addition, unless prevention efforts successfully reduce the toxicity of all products, toxic constituents will remain in MSW, either because some products are toxic *per se* (e.g., pesticides) or contain substances that can be harmless in the product but pose toxicity problems during waste management (e.g., cadmium in some plastics). For these reasons, a comprehensive MSW strategy must consider both prevention and management.

OTA suggests that "materials management" has two aspects. First, MSW management should be approached on a material by material basis, in which discarded materials (including discarded products, yard waste, etc.) are diverted to the most appropriate management method based on their physical and chemical characteristics. Second, the manufacturing of products should be coordinated with the needs of different management methods (e.g., by designing products for recyclability) (see figure 4).

To establish a framework for deciding how to manage MSW when it is generated, OTA considers materials and energy conservation (already stated as objectives in the Resource Conservation and Recovery Act, or RCRA) to be national goals, and assumes that each management method is designed to ensure the safety of human health and the environment. The framework developed by OTA suggests that local decisionmakers consider recycling (and composting) first, followed by incineration and landfilling, recognizing that all of these management methods may be needed.[9]

Recycling is given the top priority based on: 1) its materials conservation benefits compared with incineration and landfilling and 2) its energy savings, at least for some materials such as aluminum, compared with manufacturing using virgin materials. Further, assuming that adequate regulations exist for both primary and

[8]There are signs of change at EPA, however—for example, a proposed policy statement on pollution prevention (54 *Federal Register* 3845, Jan. 26, 1989). Various pollution control agencies also have endorsed this concept (e.g., WPCF 1989). How applicable these policy statements will be to MSW, as opposed to hazardous waste, remains to be seen. However, a recent EPA report devoted to MSW stressed the idea of MSW prevention (EPA, Feb. 1989).

[9]Although the term "hierarchy" is often applied to MSW, OTA does not use the term because it suggests a rigid, linear approach to decisionmaking.

secondary manufacturing facilities, recycling may produce fewer pollutants overall.[10] Incineration of combustible wastes is given preference over landfilling because it destroys pathogens and organic materials, decreases the volume of waste destined for landfills, and often can be used to recover energy economically.

At the local level, communities would use this framework to decide how to manage particular materials *in light of local conditions*. This entails considering factors such as: human health and environmental risks, management costs (including capital, operating, and collection/transportation costs), availability of technologies, market conditions for secondary materials, and public acceptance of various alternatives. Although many communities have explicitly or implicitly adopted a MSW "hierarchy," they generally have not considered all of these factors. A national policy of materials management would encourage more complete consideration of these factors. A materials management strategy should also be flexible, so that MSW management methods can be chosen on the basis of regional and local variations and limitations, and changes in these conditions over time.

Implementing a materials management approach at the local level will require MSW to be thought about in terms of its components instead of as an indistinguishable mixture. This means that residences and commercial establishments will have to keep some waste materials separate to make subsequent management safer and more economical.[11] For example, separating yard waste for backyard or municipal composting can reduce, to some extent, leachate from landfills and nitrogen oxide emissions from incinerators. Separating recyclable materials before they are mixed with other waste improves their quality, thus making them more valuable and easier to market.

Implementing a national policy that emphasizes MSW prevention and materials management would require strong Federal leadership. Congress has the opportunity to provide the basis for such leadership during the reauthorization of RCRA, the primary Federal authority regarding MSW (box B).

The remainder of this summary presents specific policy options for Congress to consider. Each policy option is discussed in the context of the technical material that will be presented in OTA's final report.

POLICY OPTIONS

Introduction

Decisions about how to manage MSW today and tomorrow are becoming increasingly difficult, particularly for the local governments that have primary responsibility for MSW management. The Federal Government respects State and local primacy in MSW issues and to date has assumed a limited role in MSW management. EPA has primarily focused on developing guidelines for Subtitle D landfills and for procurement of products containing recycled materials. During the late 1970s, EPA also encouraged the development and implementation of Solid Waste Management Plans by States (box B). In general, Federal attention to MSW lapsed during the 1980s, primarily because the Nation focused instead on hazardous waste. Some States and communities, even without Federal involvement, have developed noteworthy programs promoting recycling and requiring that new incinerators and landfills use the best technologies available.

[10]Primary manufacturing refers to production with virgin materials; secondary manufacturing uses materials recovered from waste. If recycled products replace products made from virgin materials, potential pollution savings may result from the avoidance of manufacturing and subsequent disposal of replacement products made from virgin materials.

[11]Separation can occur, for example, at dropoff centers, through curbside collection, or in centralized facilities. The choice is not always clear, even on a technical basis.

EPA's recent "Agenda for Action" (EPA 1989), which outlines goals for the Nation and future MSW activities at EPA, signifies increased attention to MSW at the Federal level (box C). The success of EPA's efforts, as well as other activities within the public and private sectors, will in part depend on how Congress addresses MSW issues in the upcoming reauthorization of RCRA.

At least two important MSW concerns are driving the Federal Government to re-examine its role with respect to MSW issues. The first is the decline in existing landfill capacity, along with the inability of many local governments to site new MSW facilities of any type. Second, several issues have arisen with consequences that extend far beyond any one community, and these seem most feasible for the Federal Government to address. One such issue, for example, is the need to encourage manufacturers to consider the MSW management implications of their products (e.g., volume, toxicity, or recyclability) as they are designed.

The policy options discussed here focus on possible congressional actions. Options that can be undertaken independently by or in coordination with other entities (e.g., State and local governments, Federal agencies, and the private sector) also are noted. Specific actions regarding MSW are likely to be more effective if they are delineated in the context of a coherent, comprehensive approach for the Nation, and this can only be done if a national policy for MSW is established. *Congress can provide strong leadership by stating a clear national policy for MSW*, one that contains clearly articulated goals and sets priorities for action. Such a national policy could set the stage for moving toward a balanced, long-term approach to MSW problems. Appropriate goals might be:

- set MSW prevention as a national priority (i.e., reducing MSW toxicity and quantity);
- set the development of sufficient MSW management capacity throughout the Nation as a national priority;
- promote the use of management methods that provide materials and energy recovery benefits; and
- regulate MSW management methods so that each ensures adequate protection of human health and the environment, and vigorously enforce these regulations.

Policy options are discussed here in two major sections. The first section discusses options related to the Federal role in enhancing the institutional framework for MSW (e.g., ensuring capacity, aiding planning and coordination). These options address issues associated with **both** prevention and management. The second section consists of four parts analyzing options for programs and activities specific to prevention, recycling, incineration, and landfilling. Many of the options are related in that they all are oriented toward implementing the goals stated above and an institutional framework for MSW. Table 1 lists these options.

Enhancing the Institutional Framework

The system that generates and manages MSW includes a range of participants that manufacture, distribute, consume, and dispose of materials and products. Key components of this system are listed in box D to highlight where specific options might be applied most effectively. The institutional framework includes the governmental entities that affect the interactions between these participants. Five categories of options to enhance the institutional framework are discussed: improving integration (planning and coordination), ensuring capacity, promoting enforcement, improving information flow, and devising funding mechanisms for Federal activities.

Integration: Planning and Coordination

A coherent strategy will be required to avoid the piecemeal approach of past MSW policies. Cooperative efforts already are increasing, espe-

cially between States and local governments and between these levels of government and the private sector. In many cases, however, there is a critical lack of teamwork between affected groups, particularly with respect to waste prevention and recycling. As the Federal Government further defines its role in MSW issues, the limits of its authority need to be delineated and the implications of this authority for actions by State and local governments need to be considered carefully.

Option 1: Require State MSW Management Plans

Careful planning is crucial to the development of effective MSW programs, especially given the time and resources required for implementation. It is an open question what the Federal role should be in MSW planning. The Federal program for State Solid Waste Plans (RCRA Section 4002) essentially has been inoperative since 1980. Some States have continued to develop their own plans, but the content and utility of these plans varies. Because all State plans are not comprehensive in their approach to MSW, *Congress could require States to submit plans to EPA and specify particular issues that must be addressed.*

State plans, for example, could be required to provide: 1) programs to encourage prevention and administer materials management; 2) coordination mechanisms among State and local agencies and the private sector; 3) specific information on the amounts and composition of MSW generated; and 4) assessments of how adequate management capacity will be made available for MSW generated in the State. In addition, Congress could provide specified Federal funds to States with approved plans and/or withhold funds from those whose plans were not submitted or could not be approved.

Although States currently are not required to submit Solid Waste Plans, RCRA does list a number of requirements which must be met if submitted plans are to be approved (RCRA Section 4003). For example, one requirement is that the plan evaluate the size of waste-to-energy facilities (i.e., incinerators that generate electricity) in relation "to the present and reasonably anticipated future needs of the recycling and resource recovery interest within the area encompassed by the planning process" (RCRA, Section 4003(d)). Some of the RCRA requirements need modification, however. Some specified requirements may no longer be relevant and new issues may warrant inclusion. For example, because recycling cannot provide a consistent level of management due to fluctuations in market prices, it might be useful if plans were required to address procedures for how MSW will be managed during periods when market prices for secondary materials drop below a certain level.

Option 2: Interagency Coordination

To ensure that a more coherent and coordinated Federal effort is developed, *Congress could require that EPA and other Federal agencies establish an action-oriented interagency task force to review and coordinate Federal activities and policies that affect MSW generation and management.* A task force also could develop methods to compare the effectiveness of different programs. The primary difficulty facing such a task force, however, would be ensuring that its recommendations are implemented or at least considered seriously. Congress could require that the recommendations be reviewed and plans for implementing them be made by EPA and other agencies, unless there are demonstrable reasons for not doing so.

Ensuring Capacity: Siting, Interstate Transportation

Citizen opposition to the siting of new facilities remains widespread in many areas, even when the facilities would meet strict standards, but some new incinerators, landfills, and recycling facilities are being built. Siting a new facility can take 7 years or more, and an additional 2 to 3 years to obtain a permit and

construct the facility.[12] Various studies indicate that if the public is involved *early* and *substantively* in the process of selecting, evaluating, and locating facilities, the chances of successful siting are improved significantly.

Interim solutions will be needed to meet immediate capacity needs in areas that will exhaust their current permitted capacity within a few years and that have been unable to site new facilities. The most common interim solutions are increased transportation of MSW to other jurisdictions and expansion of existing landfills. Shipping the waste elsewhere often is the only option. Many communities with available capacity, however, are increasingly unwilling to accept MSW from other jurisdictions. Some States have enacted bans or restrictions on waste from out-of-State (or localities have enacted such restrictions against other localities within a given State). Some of these restrictions have been invalidated when the courts have determined that the bans unduly constrain interstate commerce.[13]

Option 1: Barriers to or Compacts Against Interstate Transportation

One alternative for addressing jurisdictional problems is to provide a mechanism for cooperation in interstate MSW transportation. For example, interstate compacts have been used to deal with issues such as low-level radioactive waste disposal, navigation and flood control, water pollution control, community development, and crime prevention (Kovacs 1988). In fact, provisions exist in RCRA (Sections 4002(a) and 4006(c)) that encourage interstate regional planning to facilitate MSW management. These provisions have not been implemented, but could provide a basis for allowing States to enter into agreements on MSW issues such as transportation of wastes, disposal fees, or development of new management facilities. Instead of erecting a barrier, this would allow wastes to move unimpeded across State lines, but in an orderly manner.

Assuming compliance with the Commerce Clause, which allows the Federal Government to regulate interstate commerce, *Congress could allow States to impose fees or other legal barriers on MSW imports.* Or, Congress itself could impose fees on MSW transported across State borders or adopt other mechanisms to discourage interstate shipments. These choices have important implications. Not least, they would represent a major change in the Federal approach to both interstate transportation and MSW management. In addition, although some States may want authority to restrict MSW shipments to their jurisdictions, other States (particularly those with adequate available capacity) may oppose attempts to restrict interstate transportation of MSW.

Option 2: Require States to Ensure Adequate Management Capacity

As part of the State solid waste planning provision in RCRA, *Congress also could require "capacity assurance" for MSW—that is, require States to ensure that adequate management capacity is available within specified time periods.*[14] "Adequate" could be defined as the ability to manage a specified percentage of the MSW generated within a State's borders. One mechanism to encourage the development of new capacity would be to require that permits to expand existing landfills only be in effect for a limited time and include an enforceable timetable for providing new capacity. Federal funding (e.g., Superfund money or highway funds) to States could be contingent on meeting this and other State planning requirements.

[12]In the future, with new siting procedures, the time required to site facilities may be reduced.

[13]See Kovacs and Anderson (1988) for discussion of the relevant court decisions.

[14]See footnote 4.

Option 3: Develop Model Siting Procedures

Another option is to establish better procedures for siting facilities. *Congress could direct EPA to develop guidelines for State siting procedures.* Such procedures could, for example, require binding arbitration by a State authority when siting conditions cannot otherwise be negotiated successfully. Similarly, the Federal or State Governments could provide resource or mediation teams to help local communities resolve siting disputes. To enforce these requirements, Congress could withhold Federal funds from States that did not meet the capacity requirement, or it could provide supplemental funds to States that meet siting goals or adopt a siting process.

Enforcement

RCRA does not include any specific enforcement procedures for MSW. This is not surprising, given the currently limited Federal role in this policy area. The only existing mechanism in RCRA for Federal action against improper disposal of MSW is Section 7003 (42 USC 6973), which grants EPA broad authority to bring suits for action against any entity (as defined by the Act) whose "past or present handling, treatment, transportation or disposal of any solid waste [including MSW] or hazardous waste may present an imminent and substantial endangerment to health or the environment."

Such suits might help States or localities bring about necessary, but politically difficult, actions (e.g., denying a permit to expand a landfill known to be hazardous, but which offers the only readily available capacity), or might correct State actions inconsistent with the stated goals of RCRA. To date, EPA has made limited use of this authority, consistent with its general deference to States on MSW issues.[15]

Option 1: Define a Stronger Enforcement Role for EPA

Congress could define a stronger enforcement role for EPA by requiring that Federal permits be issued for the handling, treatment, and disposal of MSW. If Congress were to choose this option, it would also need to address how to coordinate Federal enforcement efforts with those of State and local governments. This option has several implications. First, it raises the question of how a Federal permitting program would be structured. For example, EPA's air and water programs are designed so EPA delegates the actual permitting and enforcement authority to the States but reserves the right to oversee the permitting process, take enforcement actions, and take over programs that are not functioning properly. Substantial resources would be needed for EPA to enter the MSW arena and develop standards and guidelines, administer the programs, and undertake vigorous enforcement actions.

Congress also could address the levels of civil and/or criminal penalties that can be assessed for violations of existing and future Federal requirements. Some States are increasing the civil and criminal penalties for improper waste management and are placing high priority on enforcement actions because they fear that the increased costs of complying with new MSW regulations could lead to increased illegal disposal. *Vigorous enforcement and imposition of stiff penalties are necessary to provide a strong disincentive for improper management.* The ability of citizens to sue the Federal Government for lack of enforcement (Section 7002) also is a potentially important mechanism to ensure Federal implementation of existing regulations.

Improving the Flow of Information

The success of any national effort to adopt a waste prevention and materials management policy and manage MSW effectively will de-

[15]See box B, as well as RCRA Section 4005(c).

pend heavily on the quality and dissemination of key information. "Information" is broadly conceived to include not only knowledge and data needed by decisionmakers about the generation of MSW and management of materials, but also adequate education and research efforts.[16]

Option 1: Information Clearinghouse

Legal authority to create an information clearinghouse already exists in RCRA (Section 8003), yet one has never been established. Although EPA has plans to establish one (EPA 1989), Congress could specify a timeframe for doing this and address the functions of the clearinghouse. Alternative approaches also are available, for example, establishing a quasi-governmental organization based on a cooperative agreement among government, business, and the public. Such an organization could perform several functions, perhaps more efficiently and flexibly than a government clearinghouse. Regardless of the form chosen for the clearinghouse, the centralization of MSW information programs could help reduce the duplication of effort now occurring as more and more communities reconsider MSW collection and attempt to control increasing management costs.

To aid MSW prevention efforts, the clearinghouse could offer technical and economic data on labeling, MSW generation, sources of toxic substances in MSW, trends in products and packaging, and actions that individuals can take to reduce MSW generation. This information could help consumers and public interest groups identify ways to change their purchasing decisions, and it could help industrial producers, especially smaller companies with limited technical resources, make use of techniques developed by others. For example, information about certain kinds of product design changes and chemical substitutions might be transferred across products and industries, assuming the information is not proprietary.

With respect to recycling, a clearinghouse could provide information and assistance on: 1) specifications regarding secondary materials quality and methods for ensuring quality control; 2) secondary materials prices and production (which could be provided by the Department of Commerce under existing RCRA authorities); 3) technical developments that minimize costs and improve the quality of secondary materials; and 4) collection programs for secondary materials. It also could provide guidance to consumers about recycling different materials, as well as assistance to businesses (e.g., by providing information about recycling networks).

The clearinghouse also could provide performance, design, and economic information for incineration and landfilling. In addition, a clearinghouse could develop procedures to evaluate the costs and effectiveness of different management programs. For example, a computer model that helps communities assess the comparative costs of various management scenarios could be housed and accessed through the clearinghouse.

One key function of a clearinghouse would be to disseminate this information. Moreover, a clearinghouse could foster its collection and compilation, and it could identify and address important information gaps. External activities, such as conferences and workshops, could support these efforts. Special institutes could be established to gather information on specific materials for which information currently is not collected. "Peer matching" programs, similar to those sponsored by EPA in the past, could help communities identify other communities with facilities or programs similar to those which they might be considering.

[16]Many of the institutional structures needed to collect and disseminate information, sponsor research, and encourage education are the same for both prevention and materials management (particularly recycling), which suggests that programs might be most efficient if they address both elements together.

Option 2: Education

The Federal Government also has opportunities to improve education about MSW prevention and materials management. To sustain new efforts in these areas, it is critical that the Nation's children—the next generation of consumers—be well-informed about the entire MSW system and the environmental implications of how the Nation uses natural resources. The links between the extraction of virgin resources and the mounds of waste that are discarded daily must be made more apparent to the next generation than they are to most Americans today. Both manufacturers and consumers need to know how their decisions about products affect MSW generation and management, and what opportunities exist for making changes that lead to MSW prevention or increased recycling. States and localities with established recycling programs usually cite the importance of education—particularly at the grade school level—in the success of their efforts.

Congress could encourage Federal MSW educational efforts through a number of specific options. For instance, EPA and the Departments of Commerce and Education could sponsor conferences with industry and local and State officials to develop educational materials, and EPA could undertake educational campaigns of its own. Congress also could provide funding for educational grants and programs.

The Federal Government also could promote household hazardous waste collection programs to educate citizens about alternatives to toxic products. Public concern over the proper management of household hazardous wastes (e.g., discarded solvents, paints, batteries, and cleansers) is evident, and special collection and management programs for them are increasing throughout the country. Although such programs may be expensive and their significance in terms of risk reduction is not known, they are useful tools for educating the public and manufacturers. Public service advertising could also be used to educate people about MSW issues. One private sector example is a joint campaign by the Environmental Defense Fund (EDF) and The Advertising Council to promote recycling (EDF, Sept. 1988). The campaign uses TV, radio, newspaper, and magazine advertisements.

Option 3: Increase Federal Research

Another option available to Congress is to increase Federal research funding on MSW issues for agencies such as EPA, National Institute of Standards and Technology, Forest Products Laboratory, Bureau of Mines, and the Department of Energy. EPA, for example, listed specific topics that merit additional research in its "Agenda for Action" (EPA, 1989) and is compiling a detailed list of research and development projects as part of a Municipal Innovative Technology Evaluation Program (Greenblott, 1988).

Funding for Federal MSW research should address at least two areas: 1) developing evaluation methodologies to assess the effectiveness of prevention and management programs; 2) exploring innovative methods and technologies for MSW prevention (e.g., developing substitutes for toxic substances, designing products to be more durable or to generate fewer residuals); and 3) exploring innovative methods and technologies to improve MSW management (e.g., new uses for secondary materials, enhanced degradation of MSW in landfills, improved processing techniques for residues from waste management, testing procedures for ash from recycling and incineration facilities).

Funding

An important concern when considering any new Federal policy or program is how such activities will be funded. In general, new or independent sources of funding are desirable, rather than expecting new programs to compete with existing ones for scarce budget dollars. Federal revenues would be necessary to fund many of the Federal activities that Congress

could require for MSW prevention and materials management.

Funding for planning and implementing MSW prevention and management programs, of course, needs to be developed by all levels of government. Some funding mechanisms used at the State level could be applied at the national level as well, perhaps more effectively. Other funding options might be more appropriate or feasible for State and local governments, or for any level of government, to apply.

Federal options for raising revenues are available. These options include fees on packaging and/or other products, user or "waste-end" fees, and a national income tax. *Such fees, in addition to raising funds for MSW programs, possibly could help internalize the costs of waste generation and management, if they are set at high enough levels.* For example, high fees might create an incentive for manufacturers to consider the impact of products on the waste stream when they are designing new products.

Fees of any sort are likely to be discriminatory, since it is cumbersome to apply fees on all parts of the waste stream equally. They also can be difficult to administer, given the number of entities potentially subject to the fees (e.g., manufacturers, retailers, distributors, consumers). Some types of fees may be better able to overcome these obstacles than others.

Option 1A: Product Fees

One option is to impose a fee either on the virgin materials used in packaging and containers or on the packages and containers themselves. Proposals have been introduced in several states, for example, to impose a tax on packaging and containers, with the level of the tax varying based on whether a product is recyclable and/or made of recycled materials. In addition, requiring products to be labelled accordingly would help consumers make purchasing decisions based on these considerations. The advantage of this approach is that the fee also might affect decisions regarding product design and manufacturing.[17] In addition, this fee could generate significant revenues, although it is not clear whether a decrease in MSW generation or an increase in recycling would occur as a result.

Because packaging and containers are estimated to account for about 30 percent of the waste stream by weight, this is a selective or discriminatory measure. However, a fee based on a specific subset of products can be justified as consistent with the goals of prevention and materials recovery. It can be argued that packaging and containers are a significant, visible, and problematic portion of the waste stream and therefore warrant such discriminatory measures. A more equitable proposal is a fee on *all* products that become MSW. However, this approach would be cumbersome to administer because of the large number of products and manufacturers involved.

Option 1B: User or Waste-End Fee

In contrast to these "front-end" approaches, a user or "waste-end" fee could be charged on a weight or volume basis when MSW is sent to management facilities. Some communities and States already administer such fees for particular facilities or for "problem wastes" (e.g., tires and batteries), and they use the fees to fund research and special management programs.

If a waste-end fee was applied to all MSW sent to management facilities, and consumers were billed directly (at households and commercial establishments) by the waste haulers to recover the fees, it could create an incentive for consumers to consider the quantity, durability, and even toxicity of products. In turn, changes in consumer decisions could pressure manufacturers to address the potential for MSW prevention when products are designed and manufactured. Moreover, if the administering govern-

[17]The specific rate per ton for this or any similar fee could be based on the level of funding needed to support various activities. OTA makes no judgment in this report on what funding level would be needed.

ment wished to promote one management method over others, it could alter the fees as necessary. It is not known how large user fees would have to be to accomplish these goals. Furthermore, given that the amount needed to promote a particular method is likely to vary locally, such an approach is likely to be most feasible at the local level.

Concerns have been raised that user fees could lead to illegal disposal by consumers or haulers. However, some evidence exists that consumers will respond to increased waste disposal charges by changing their purchasing decisions and, for example, recycling more MSW (Riggle, 1989).

Option 1C: National Income Tax

Another possible option would be to establish a special income tax paid by all citizens. Although an income tax may not be politically feasible, even at a low rate it could raise significant revenues. For example, over $300 million would be raised annually if the rate charged was $1 per person for an individual or family with an adjusted gross income of less than $25,000 and $2 per person for higher incomes. This option is equitable—every person produces garbage. Distributing these tax revenues to various MSW programs also could be justified by potential future reductions in management costs to the public and an improved environment. Moreover, this system would be administratively simple to implement. While it could be referred to as a waste generation fee, rather than a tax, one disadvantage is that it could be viewed as setting an unwanted precedent for establishing taxes linked to specific issues.

Specific MSW Program Options

Waste Prevention

Reducing the amount or toxicity of MSW is a *preventive* action, and thus it has a fundamentally different function from waste management.[18] *Reducing MSW generation and toxicity offers many potential benefits*—fewer environmental problems with waste management, lower waste management costs, increased conservation and efficient use of resources (including materials, energy, and land associated with waste generation and management), and increased public confidence in government MSW policies and in industry.

Several obstacles have precluded substantive waste prevention efforts to date. Some of these are cultural or economic (i.e., market-driven). For example, one deterrant is that manufacturers have little incentive to consider the problems or costs of MSW disposal when they design and make a product because most products do not become waste until long after leaving a factory.[19] Similarly, individual consumers currently have little economic incentive to consider the implications of their purchasing and consumption patterns.[20] Another consideration is that reducing MSW generation is inconsistent with America's demand for convenience and disposable products and, for that matter, for all types of products (box A). Containers and packaging, which are mentioned frequently as potential targets for waste prevention efforts, are a large and visible part of MSW, but they serve many functions (e.g., sanitation, theft prevention, public safety, weight reduction, customer appeal) that must be considered.

[18]The precedent for prevention efforts exists with hazardous wastes (OTA 1983, 1986, 1987a). Although MSW probably is not as great an overall threat to human health and the environment, the Nation has an opportunity to shift its thinking toward a more preventive mode for MSW as well.

[19]This is different from the situation with industrial wastes, especially hazardous wastes, produced at a manufacturing plant itself. In that case, the waste comes directly from production processes and disposal costs can be linked directly to the processes. Products and materials only become MSW, however, after they have been used for some purpose.

[20]This is in part because MSW management costs usually are paid either through municipal taxes that cover many services or by institutions and businesses, not by individuals. Even if costs rise, there is no assurance that they will reach a sufficiently high level to cause changes in consumption patterns.

The likelihood that production and consumption patterns will change hinges on behavioral and cultural attitudes, as well as economic considerations, and thus it is difficult to estimate whether and when prevention, particularly in terms of quantity, might have a significant effect on MSW. Also, since there is no standardized way of defining and measuring prevention, it can be difficult to know when it has occurred.

Prevention and recycling efforts can sometimes work at cross purposes. For example, multi-component "barrier" plastic bottles (i.e., bottles made of several layers and types of plastics) are now being used for products such as ketchup and syrup. Although this design reduces the weight of waste generated, glass bottles can be more readily recycled. The new plastic bottles are complex mixtures and can only be recycled into items such as lumber substitutes, and few facilities exist to do such recycling.

Another constraint is that State and local officials, the traditional decisionmakers for MSW management, can do little to influence manufacturing decisions or consumer buying patterns. Most products are marketed in more than one State, and officials cannot easily mandate changes in products that flow in interstate commerce. In addition, manufacturers that market products in more than one State can face severe difficulties if they have to meet varying State and local requirements on products and packaging.

Strong Federal actions, however, might overcome the various obstacles to MSW prevention, change general perceptions about its feasibility, and ensure that attention is not focused solely on developing management capacity. Possible options for Federal efforts can be grouped into four categories:

- establish goals for quantity and toxicity reduction, and give prevention high priority within EPA and other Federal agencies;
- provide economic incentives (e.g., grants, awards, procurement);
- improve information flow to the public and manufacturers (e.g., labeling, waste audits, research, clearinghouse); and
- ban specific products or substances.

In addition to these options, another critical activity will be educating manufacturers and consumers about prevention possibilities (see "Education" above).

Option 1: Develop National Goals and Assure Them High Priority

Option 1A: Goals to Reduce the Volume of MSW

Congress could set incremental goals to reduce the quantity of MSW generated and thus help focus attention on the potential offered by prevention. One reasonable goal would be to attempt to offset estimated future increases in MSW generation. Since per-capita generation and population growth are each increasing by about 1 percent annually (box A), an initial prevention goal might be 2 percent per year.[21] Such a goal symbolizes a long-term commitment, yet it should not prove disruptive to the economy or consumers. If this could be achieved, the volume of MSW generated would remain constant and local officials would have to manage the same amount of MSW as they do now.

Setting such a goal raises several problems, however.[22] First, how would quantity reduction be measured on a national basis? Given the range of uncertainty in estimates about MSW generation, any change on the order of 2 percent would be overwhelmed by estimating errors, and it would not be clear whether a real change

[21]The 2 percent figure is an example of a goal, not an indication of how much prevention is possible.

[22]These problems also are associated with setting goals for any management method (e.g., see "Recycling" below).

had occurred.[23] Second, even if quantity reduction (and associated savings in waste management costs) could be measured, it would still be difficult to resolve all potential tradeoffs, particularly to quantify other potential benefits (e.g., using less materials and energy) and costs (e.g., effects on GNP and convenience) offered by prevention and to assess the performance and effects of new or alternative products. Quantity reduction also has to be evaluated in terms of its effects on MSW toxicity; for example, using cadmium-coated bolts to reduce corrosion might make bolts more durable and reduce waste, but it also can increase potential toxicity when the products are discarded in MSW.

Option 1B: Goals to Reduce the Toxicity of MSW

If toxic substances in MSW that pose risks to the public and the environment could be identified and then eliminated from products and materials that become MSW, then recycling, incineration, and landfilling facilities would be safer and conceivably easier to site and operate.[24] This might even abate the need for quantity reduction. In addition, manufacturers might lower their own costs by reducing their use of toxic chemicals in production. Examples reviewed by OTA demonstrate that reducing the amount of toxic substances in some products is technically feasible and is actually occurring, at least on a limited basis.

Many toxic elements serve important functions in products (e.g., cadmium as a heat stabilizer in some plastics). However, it is sometimes possible to identify more benign substitutes (e.g., to replace metal-based inks, synthetic organic pesticides) that are not prohibitively expensive. Identifying targets for toxicity reduction efforts involves distinguishing substances of concern, particular products containing the substances, and likely reductions in toxicity. Thousands of products become MSW, and it is difficult to trace the lifecycle—from design to discard—of substances or their potential substitutes in these products. In many cases, proprietary considerations constrain public evaluations of substitute substances (e.g., a substitute for mercury and cadmium in household batteries). Requiring industry to conduct waste audits might help alleviate these problems.[25]

As an initial goal, Congress could require EPA to identify those metals and organic chemicals likely to contribute significantly to the risks associated with MSW management. EPA could then be required to study a given number of those substances each year.[26] For each substance, EPA could evaluate product sources, technical feasibility of elimination or of substitution with benign substances, effects on potential risks, economic and social costs to industries and consumers, and incentives and/or regulatory initiatives likely to be effective in achieving reduction. This would be similar to EPA's current efforts on lead and cadmium (Franklin, 1989).

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[23]The same might be true for the estimate that per-capita generation is increasing by about 1 percent annually, because it is based on a model of how materials flow through society. In both cases, standardized methods have not been developed for measuring changes based on *actual* generation and collection.

[24]It is important to note, however, that some environmental problems associated with MSW management have little to do with toxic substances in products. For example, methane emissions and acidic leachate are both generated from the natural decomposition of organic materials in MSW (e.g., yard wastes, paper). In addition, small industrial and commercial generators of hazardous wastes can legally dispose of them along with ordinary MSW.

[25]Waste audits, conducted during the design of a product, identify potential byproducts and impacts of production and use of the product on the wastestream.

[26]It has proven difficult for EPA to identify toxic substances in a systematic way for regulation. Alternative approaches that would shift the burden of proof to manufacturers could be considered. For example, manufacturers could be required to evaluate the effect of using a given substance on human health and the environment.

Option 1C: Assure High Priority for MSW Prevention in Federal Agencies

Federal efforts to promote prevention are most likely to succeed if they have high visibility and support, particularly at EPA. Congress could direct EPA to give high priority to MSW prevention efforts. For example, Congress already is considering establishing a high-level EPA office for waste minimization.[27] This office could devote some resources to MSW prevention efforts (e.g., providing grants and awards, establishing an information clearinghouse, analyzing effects of new regulations on the potential for prevention). These efforts are unlikely to entail major costs to the Federal Government. Furthermore, authorizing such spending by EPA would send a signal about the seriousness of Federal efforts.

Congress also could require all Federal agencies to establish a "MSW prevention officer" position. The responsibilities of this position could include promoting prevention, reviewing agency activities with respect to impacts on MSW generation, and coordinating efforts with EPA. The position could also be given similar responsibilities with respect to procurement and recycling, although this might draw some attention and resources away from the prevention efforts.

Option 2: Provide Economic and Other Incentives

Option 2A: Grant Fund

Congress could provide direct economic assistance to projects designed to promote MSW prevention. For example, it could establish a *grant fund*, financed by one of the funding mechanisms discussed above. A grant program could be administered by EPA, an interagency task force, or a national commission. Whatever group administers such a program, it could select projects, review project performance, provide public accountability of the results, disseminate results, and prepare an annual report to Congress.

Activities that might be eligible for grants could include: 1) industrial research and development projects; 2) capital investments to modify manufacturing plants to produce products that create less MSW or have fewer toxic substances; 3) outreach programs to educate consumers about their role in MSW generation and prevention; 4) research projects on removing institutional and social obstacles to prevention; and 5) innovative ideas for use by nonmanufacturing businesses (e.g., retailers, service providers, advertising or marketing companies).

Option 2B: High-Visibility Awards

To focus national attention on MSW prevention and provide incentives for its practice, Congress could authorize annual awards for noteworthy prevention accomplishments. These could be Presidential awards, similar to the Malcolm Baldridge National Quality Awards (P.L. 100-107) established by Congress to motivate American industries to increase their competitiveness through improved product quality. Alternatively, an awards program could be developed and administered by EPA, the Department of Commerce, or a national commission. The range of possible recipients is broad: manufacturers, individual researchers, nonprofit and public interest groups, marketing companies, and government agencies.

Option 2C: Federal Procurement

Federal procurement programs exist to purchase products made from some secondary materials, allowing prices that are slightly higher than those for products made from virgin materials. These programs could be extended to products that generate less MSW or are less toxic, such as water-based inks. Congress could

[27]EPA established an Office of Pollution Prevention, but the primary focus of the office has been on hazardous wastes; in addition, it does not have agency-wide visibility.

explicitly require Federal agencies not to discriminate against such products (except where they are not available or do not meet critical technical specifications) and authorize a 5 percent to 10 percent price preference for such products, a level similar to those in State procurement programs for recycled goods.

The major benefits of such a program would be to: 1) strengthen the leadership role of the Federal Government; and 2) provide an initial market for these products, which could help reduce financial risks faced by manufacturers if they attempt to change product design or composition, or risks faced by service providers trying to change some aspect of how they do business. As with any procurement programs, two important drawbacks exist: defining exactly what products qualify for preferential treatment, and inducing Federal agencies to actually make such purchases.

Option 3: Improve Information Flow

Option 3A: Develop Labeling With Prevention Information

Labels often are used to convey key information or ideas about products and influence purchase decisions (e.g., "no cholesterol" and "no caffeine" labels on many food products). One option is to authorize the use of a special logo on products that are considered to benefit the environment or help resolve waste management problems. In West Germany, for example, the Federal Environmental Agency has given "Environmental Angel" awards to companies for such products (figure 5). The angel logo can then be used by the companies to market the product. Canada is instituting a special label for products that are recycled, recyclable, biodegradable, energy conserving, or free of ozone-depleting substances (Environment 1989), and similar systems are being considered in Norway and Japan (Worldwatch 1989). Similarly, labeling on "reduced waste" products could be used in the United States by manufacturers to gain advantages in the marketplace, by retailers to implement marketing efforts, by procurement offices to determine product preferences, and by consumers to guide purchasing decisions.

Another idea is to use the ratio between the amount of MSW ultimately generated and the amount of useful product (OTA Workshop, July 1988). Other ratios conceivably could be developed to address toxicity, durability, repairability, and reuse. The information could be coded by color, symbol, or numerical ranking, as long as the system was easily understood. However, the information needed to make these judgments (e.g., volume, durability, toxicity, or repairability and reusability) is complex and often unavailable. Congress has several options to address the labeling issue. One approach might be to mandate establishment of design institutes or product review boards, or direct Federal agencies (e.g., EPA, Consumer Products Safety Commission, National Institute of Standards and Technology) to begin developing technically sound methods to rate products on MSW-related criteria.

Alternatively, a commission or advisory panel could be appointed to study and make recommendations regarding labeling programs. To ensure that the recommendations are turned into actions, Congress could give the commission a blue-ribbon status and require the EPA Administrator and Secretary of Commerce to review and implement the recommendations, unless they could demonstrate sufficient reason for not doing so. The commission could assess standardized ways of defining and measuring prevention, types of labels, criteria for labels, categories of products to target, how to determine success (in terms of actual toxicity or quantity reduction), past labeling efforts, educational opportunities, social and economic costs of labeling and prevention, and how to address imported products (e.g., legal or trade agreement limitations to labeling requirements on imports; whether data on toxicity could be required).

Option 3B: Data on MSW Generation

Federal prevention efforts will need accurate and up-to-date information on many aspects of MSW, including the quantity or toxicity of specific products; the impacts of new products and social trends on MSW generation; and the generation of MSW by different sectors (i.e., residential, commercial, institutional). This type of information would be useful for MSW management programs, as well. Congress could direct EPA to establish an ongoing program to conduct specific studies on MSW generation and potential prevention targets; for example, these studies could address:

- the quantity and toxicity of MSW generated by residents and commercial and institutional establishments, especially in terms of different products;
- the effects of educational efforts (e.g., measuring how consumers change their habits when prevention goals are clearly articulated);
- future changes in MSW generation patterns at the community level to gain an understanding of how prevention might help local MSW management;
- targets for prevention efforts, in terms of both quantity and toxicity, and the potential costs and benefits of such efforts.

Industry also could provide important information, particularly about toxic substances. Industries could be called on to perform waste audits or draw up nonbinding plans that identify potentially toxic substances in products, explore the feasibility of reducing these substances, and estimate the costs involved.

Option 4: Banning Specific Products and Substances

A more prescriptive approach to MSW prevention would be to ban products and substances that are considered undesirable.[28] Fast food packaging, some plastic products (e.g., grocery bags, foam polystyrene cups), and packaging in general are lightning rods for public attention and certain types have already been banned in some communities. These bans have strong symbolic value, and the threat of a ban can motivate private sector action to change the composition of particular products (e.g., removing chlorofluorocarbons from polystyrene foam cups).

Bans generally focus on a small portion of MSW. One study found that paper and plastic fast food packaging currently comprises about 0.3 percent by volume of the material excavated at landfills; disposable diapers (which are part plastic and part paper) comprise about 1.5 percent (Rathje et al., 1988; Rathje, 1989). Even so, this still could be useful in achieving the 2 percent goal discussed above. However, it often is not clear whether the replacements for banned products are better in terms of reducing quantity or toxicity or of using fewer natural resources during manufacturing.

Bans or regulations on using specific substances in products that become MSW may have more merit if substitutes can be found that reduce toxicity. Congress could require EPA to identify additional substances of concern and assess the effects of banning or regulating these substances pursuant to its existing authority under the Toxic Substances Control Act (TSCA).

Recycling

The current level of MSW recycling in the United States is low, about 10 percent. Although it is difficult to say how much recycling is possible, most people agree that recycling can be increased. Substituting recycled or "secondary" materials for virgin materials conserves natural resources. It also can result in varying amounts of energy savings, depending on the product and material involved.

From a national perspective, recycling is attractive and deserves precedence over incin-

[28]The use of taxes or deposits to help improve the **management** of such products and substances is discussed in "Recycling."

eration and landfilling because it can contribute to national goals such as energy and materials conservation. From a local perspective, recycling is attractive because of its potential to divert at least some materials from landfills or incinerators, which helps conserve available capacity; it also can reduce waste management costs and reduce risks to human health and the environment in some cases.

The materials management aspect of the MSW policy suggested in this report provides a framework for considering these benefits and recognizing the potential value of material resources contained in MSW. OTA has identified certain constraints to the collection, processing, and manufacturing of secondary materials (see, for example, box E) that could be reduced by government intervention. Many State and local governments and businesses already are addressing some of these limitations. Many of these efforts have been successful, particularly those related to collection, but the actual rate of increase in recycling at the national level has not been determined.

EPA is promoting an initial national recycling and prevention goal of 25 percent by the year 1992. Some cities already appear to be recycling more than this, and proponents suggest that much higher rates are possible (e.g., ILSR 1989; CBNS 1988).[29] It is safe to say that more efforts are necessary to reach that goal nationally. Although such a goal is a useful target, it does not appear to be based on a quantitative evaluation of market potential. The actual amount that recycling can be increased on a national level is not easily predicted, nor is such a prediction particularly worthwhile given the dynamic nature of materials markets.

Translating any specific national goal for recycling into action requires a close look at recycling rates for each material component of MSW. Rather than setting percentage targets for the amount of material that should be recycled, it may be more realistic to set targets for *progress* (e.g., surpassing historical rates of increase in recycling of a given material). Requiring progress rather than specific recycling rates would free planners from having to determine total market potential and would make how the baseline level of recycling for each material is calculated less important. Targets for progress could be set for each material based on economic conditions and relevant technical factors; box F indicates, on a qualitative basis, where market expansion appears particularly promising. Figure 6 presents estimates of current recycling rates for particular materials in MSW.

Regardless of the manner in which targets are set, *it is important that flexibility be maintained to allow recycling programs to be designed for local conditions*. In general, markets for secondary materials fluctuate considerably over time, often rapidly. *The ability to sustain marketing of collected materials at high levels cannot always be assured. The dynamic nature of markets is a key factor affecting the reliability of recycling as a MSW management alternative.*

This conclusion has important implications. If many communities around the country decide at roughly the same time to collect secondary materials and market them to reprocessors and manufacturers, prices for those materials may drop and some communities may be unable to market the materials they collect. In these cases, communities may have to pay an additional cost to landfill or incinerate the materials, pay reprocessors or manufacturers to take the materials, or store the materials temporarily.

[29] A recent report identified 15 communities, both large and small, that recycled more than 25 percent of their waste (ILSR 1989). However, while it is likely that these communities are recycling large amounts of their MSW, the estimates in many cases include more than MSW (e.g., construction debris, wood chips), as defined here. For example, Islip, New York, the city infamous for the Mobro garbage barge, is estimated to have a recovery rate of 32 percent. When construction debris is deleted, the estimate drops to 25 percent. This points out, once again, the problems involved in defining MSW and in calculating and comparing overall recycling rates.

Within this context, opportunities for government intervention to stimulate recycling exist in the following areas:

- information and education (e.g., clearinghouses, technical assistance, advertising, awards);
- research and development (e.g., grants, loans);
- development of standardized definitions, testing procedures, and labeling systems;
- development of health and environmental regulations for recycling facilities;
- market development (e.g., procurement programs, direct subsidies to industries to use secondary materials, local economic development, export markets);
- fees and pricing policies (e.g., changing prices and subsidies for other management methods; product charges); and
- regulatory actions (e.g., requiring secondary materials recovery, banning materials from landfills, national deposit legislation).

Although some of these actions may be most appropriately addressed by a particular level of government, many can be addressed at all levels—Federal, State, and local. Specific options within each of these areas are discussed below.

Option 1: Increase Information and Education

Information is critical to increase the ability of consumers and businesses to make decisions regarding recycling and recycled products. Currently, the Federal Government (through the Departments of Commerce, Interior, and Agriculture) provides detailed information regarding production, consumption, and prices on many virgin materials, including aluminum, steel, and wood products. However, similar information for many secondary materials is difficult to obtain, particularly historical information.

Option 1A: Improve Collection and Dissemination of Information

Congress could require Federal agencies (including the Department of Commerce, under existing RCRA authorities) to increase the collection and analysis of data on consumption, production, and prices of materials recoverable from MSW. These data are available from industries in most cases. This option, then, would only entail expanding the coverage of current data series and would not require new programs, although it might require additional funding. The information could be published in monthly and annual reports, which could be disseminated through a clearinghouse. Interagency working groups could be formed to identify new information needs and delegate collection responsibilities.

Option 1B: Increase Education

Educational programs can raise environmental consciousness and help consumers identify materials that can be reclaimed from their trash cans, as well as increase awareness of how materials are used in society. Programs aimed at elementary schools can provide long-term benefits by instilling the ideas of materials and energy conservation in young people. Education is primarily a local and State function, but the Federal Government could assist in several ways. For example, Congress could direct EPA to renew public outreach programs or specify that some portion of any grants to States be given to communities for education programs. Education also can be achieved through information provided on product labels.

Option 1C: Awards for Product Design and Labeling

Another information incentive would be to give awards or grants for innovative product design (e.g., designing existing and new products to be recyclable, as advocated by some public interest and environmental groups), new recycling technologies, and labeling systems.

EPA or the Department of Commerce could develop guidelines on how to evaluate products for awards and projects for grants.

Option 2: Research and Development

Many industries, including paper, glass, aluminum, steel, and, more recently, plastics, undertake research to enhance reprocessing capabilities, yet technologies still do not exist to adequately reprocess some materials, such as non-color-sorted glass. Technological limits also inhibit some secondary materials manufacturing processes (e.g., waste paper de-inking), and additional research could help remove them. Although some improvements are occurring (e.g., for recycling of polystyrene), technical refinements and capacity expansion take time and money. Furthermore, information developed by industry is often proprietary, thereby limiting the spread of innovation. Private industry rarely researches product design with recycling as a criterion, although this also is changing. For example, the Society of Packaging Professionals is preparing a list of simple criteria to help packaging manufacturers consider environmental effects when they make decisions about materials and containers for products (SPHE 1988).

Government-sponsored research on improvements in reprocessing and manufacturing, as well as design for recycling, could help quicken the pace of technological innovation in this area. In the past, the Department of Commerce, the National Forest Products Lab, and the Bureau of Mines have conducted research on secondary materials. For example, the National Forest Products Lab has been testing new methods to remove contaminants from waste paper (J. Klungness, pers. comm., August 1988).

Congress could encourage new research and development by providing incentives such as tax exempt bonds, low-interest loans, loan guarantees, research grants, and tax credits and exemptions. Low-interest loans and loan guarantees have several advantages: they do not require an immediate Federal revenue source and they are relatively easy to administer. Research grants require additional expenditures, but they are a traditional means of stimulating new research. Congress, for example, could establish research grant programs at EPA or the National Science Foundation. Some grants could be given to public institutions, particularly where the proprietary nature of industrial research limits expansion of recycling capacity. Or, perhaps, joint ventures between national laboratories and industry could be sponsored.

In contrast, tax credits and exemptions can result in lost Federal revenues and, more important, generally have not been proven to be effective. Most Federal tax credits employed in the past have been too small (10 percent to 15 percent) and State tax credits affect too small of a base (because State tax rates are relatively low) to have a significant financial impact on business decisionmaking.

Option 3: Standardized Definitions, Labeling, and Avoided Cost Calculations

The absence of a standardized language for recycling and recycled products hinders communication and understanding among consumers, reprocessors, manufacturers, and communities. The Federal Government has opportunities to clarify several of these hindrances by providing leadership in the areas of definitions and testing procedures, labeling, and avoided cost calculations.

Option 3A: Standardize Definitions and Testing Procedures

Standardized definitions and reporting methods for determining "recycled content" and "recyclability," along with standardized procedures to test the performance of secondary materials, would help consumers and manufacturers make decisions about secondary products and materials. Congress could instruct EPA or the National Institute of Standards and Technology to develop standardized definitions and

procedures, or to use industry standards such as those being established by the American Society of Testing Materials or the National Recycling Coalition (e.g., Ferrand, 1988). In either case, the information could be disseminated through an information clearinghouse.

Option 3B: Standardize Guidelines for Labeling

Standardized labeling guidelines could be developed to provide information about recyclability and materials content on product labels. Standardized labeling could help transfer meaningful, consistent information to consumers and, in conjunction with education programs, enhance the recognition of recycled and recyclable products. Currently, most products are not labeled to denote secondary materials content or recyclability, although the Society of the Plastics Industry has established a voluntary labeling program to identify the specific resins from which plastic containers are made. Some manufacturers are using the recyclability issue as a marketing tool; standardization could help ensure that consumers receive accurate information. Labels also could be used to denote non-recyclability.

Congress could require EPA or other Federal agencies to begin developing guidelines for standardized labeling of different products. Because the development of any labeling program is likely to be extremely complicated (as discussed above for prevention), Congress could commission an in-depth study of the entire labeling concept and consider legislative initiatives after receiving the report. To ensure that U.S. industries are not unfairly disadvantaged, Congress could extend labeling requirements to imported products.

Option 3C: Standardize Avoided Cost Calculations

The collection of secondary materials can be encouraged by providing collectors with a portion of the net savings (if any) that result from *not* incurring the cost of incineration or landfilling. This savings is known as "avoided cost."[30] When the collector is a community, the community retains the savings because its overall disposal costs are lowered, which provides an incentive for recycling. The main problem with implementing the avoided cost concept widely is the absence of an accepted calculation procedure, which makes it hard to evaluate competing claims about the costs of different waste management scenarios.

Several methods to calculate avoided costs have been suggested (Oregon DEQ, 1986; Berkman and Dunbar, 1987; Crew and Kleindorfer, 1987). Congress could direct EPA to develop a standardized procedure to ensure that appropriate "avoided costs" were used by all. The calculation could include parameters such as current landfill costs, trash collection and transfer costs, environmental costs of collection and disposal, the opportunity cost associated with tying up land as a landfill, and the discounted capital cost of developing a new landfill (i.e., when recycling occurs and conserves landfill capacity, a savings arises as the cash outlay required to construct a new landfill is pushed further out into the future). The avoided cost has to be compared with costs for collecting and processing secondary materials, all of which will change as market conditions vary.

Option 4: Regulations for Recycling Facilities

Manufacturing processes that use secondary materials generate various residuals such as air emissions, wastewater discharges, and solid waste sludges. Many of these processes are regulated to some extent. For some, however, such as facilities that process commingled recyclables, specific regulations and acceptable practices have not been developed. At the same time, other regulatory activities, particularly

[30]The use of an avoided cost calculation involves the explicit comparison of the economic value of materials and energy with the cost of land disposal; these cost comparisons will change over time.

those concerning certain hazardous wastes, have disrupted the recycling system. Both of these issues are appropriate for consideration at the Federal level.

Option 4A: Ensure Adequate Regulation of Recycling Facilities

Recycling facilities (including ones for composting) should be regulated to ensure that they do not threaten human health and the environment, just as other management facilities or manufacturing processes are regulated. Congress could require EPA to ensure that regulations (i.e., standards for design, operation, and residuals; permitting and reporting procedures) extend to all recycling facilities, including those that initially process secondary materials. Such regulations would be an important component of a comprehensive Federal MSW policy, and OTA's suggested management approach is based on the assumption that all management methods are designed to ensure adequate protection for human health and the environment. Failure to ensure adequate regulation for recycling facilities could create expensive problems in the future and increase the level of uncertainty regarding the potential for recycling.

Option 4B: Resolve Conflicts With Hazardous Waste Regulations

Regulations regarding the management of hazardous substances (e.g., lead in batteries and PCBs in washing machines, refrigerators, and other appliances) have caused some recyclers to stop accepting these products because of fears about liability and because of increased costs of complying with the regulations. In some cases, this leads to improper disposal of the products. This illustrates the need for careful consideration of the effects of hazardous waste and other regulations on recycling. Congress could direct EPA to clarify current regulations regarding the recycling of products known to contain hazardous materials, and to identify other products that might cause similar problems in the future (e.g., sodium azide in automobile air bags). EPA could begin developing guidelines for the proper handling of these kinds of products before any regulations take effect, to avoid disruptions in the recycling chain. EPA also could analyze the effect of developing regulations to restrict the use of certain materials in the manufacture of products when they pose similar problems.

Option 5: Market Development

Obviously, it serves no purpose to collect materials for which there is little or no demand (e.g., mixed plastics and mixed paper). While successful government intervention in commodity markets is difficult because of the many complex factors affecting supply and demand, several options are available to the Federal Government to help develop markets: expanded procurement, direct subsidies, economic development initiatives, and building export markets.

Option 5A: The Government As Market Maker —Procurement Programs

The most direct government approach to create new and expanded markets is to buy recycled products. This could be significant, because local, State, and Federal Governments purchase about 20 percent of the goods and services produced in the U.S. economy. In 1976, Congress directed EPA to develop guidelines for procurement of recycled materials (Section 6002 of RCRA), but EPA did not issue any final guidelines until 1988. Guidelines now exist for the procurement of some goods produced with secondary materials (fly ash in cement and concrete, paper products, retread tires, re-refined oil, and building insulation that uses secondary materials). These products are made from demand-limited materials, with the exception of recycled printing and writing paper, which is probably the most visible recycled product purchased by the government.

Congress could direct Federal agencies to increase their procurement programs for recycled products, particularly of additional demand-limited materials (e.g., old newspaper, mixed

waste paper, compost). The difficulties in expanding such programs, however, include developing guidelines about what constitutes recycled products, ensuring that agencies purchase the products, and minimizing the number of specifications for the same product that a manufacturer has to meet. In addition, it is unclear whether procurement has a substantial effect on stimulating increased recycling, although the educational effect usually is considered positive.

Additional provisions could allow private manufacturers to petition Federal agencies to purchase a product made from secondary materials instead of products made from virgin materials, and to require such substitutions unless the recycled products do not meet specifications (Kovacs 1988).

Option 5B: Direct Subsidies

Congress could provide direct subsidies to manufacturers to increase their use of secondary materials. For example, EPA (or a State using Federal grant money) could provide a direct subsidy such as a loan guarantee to a newspaper publisher to construct a newsprint mill that uses old newspapers. This type of subsidy has one major advantage—it can be targeted at specific problem materials in specific locales. It directly attacks the problem of insufficient demand (in this example, by assuring the construction of a facility that will need old newspaper), while at the same time guaranteeing a ready final market (e.g., a newspaper printed on recycled newsprint). However, competitors who have made investments without the benefit of a Federal grant might consider such a subsidy inequitable.

Option 5C: Economic Development

Efforts to build markets for recycled materials can provide economic development opportunities for State and local governments. Although the Federal Government has reduced its involvement in local economic development activities, this option remains important from the perspective of many communities. By coupling local economic development with secondary materials processing facilities, the community retains more control over the market than if the materials were consumed outside of the area. In addition, the community benefits directly because the increase in processing and manufacturing activity stimulates employment, tax revenues, and economic growth. Numerous mechanisms are available to States to promote business development, including low interest loans, loan guarantees, government equity partnerships, and direct grants (Hemphill, 1988; ILSR 1987).

Option 5D: Building Export Markets

Demand for secondary materials also could be increased by developing foreign markets. Current government programs that promote exports in general could be modified to address exports of secondary materials. For example, the Department of Commerce manages the Export Trading Company Act of 1982 (P.L. 97-290), which allows companies to operate as joint ventures and market larger quantities of products abroad without being subject to antitrust restrictions. Congress could direct the Department of Commerce to apply the provisions of this act to assist exporters of secondary materials. The Department also could be directed to identify foreign markets for recycled materials as part of its data-gathering responsibilities.

Although export markets are important outlets for many secondary materials from the United States, they are less stable than domestic markets. In addition, foreign manufacturers gain the benefit of U.S. citizens' and communities' efforts to separate and upgrade the quality of these materials. They also realize the value added when they manufacture new products. Often, foreign products made from low-cost secondary materials present stiff competition for U.S. producers.

Option 6: Fees and Pricing Policies

Fees or changes in current pricing policies could be imposed on different parts of the MSW generation and management system to stimulate recycling. These include fees to stimulate rates of progress in increasing recycling, disposal fees to change the costs of other management methods, and product charges.

Option 6A: Rate of Progress Fees on Manufacturers

If Congress were to set target goals to increase recycling of individual materials, it could encourage compliance by imposing a fee on those manufacturers or industries which fail to make adequate progress (e.g., achieve a certain percentage of recycled material in a product) by a specified date. A similar fee mechanism has been employed by the State of Florida in its new recycling legislation.

Option 6B: Increasing the Cost of Alternatives

If Congress or the States required that a user fee be assessed for using landfills and incinerators, the increased costs to haulers (who probably would be paying the fee) most likely would be passed on to their customers (who generate the waste). If the fee was large enough, it should make materials recovery more attractive economically. However, as mentioned earlier there are problems with such a system. Briefly, it would be difficult to determine the size of the fee to account for regional variation and to administer the fee on a national level. Several States have instituted successful disposal fees for waste delivered to landfills, including New Jersey and Illinois. Another application of this option at the local level might be to impose a higher pick-up fee if consumers fail to participate in curbside seperation for recycling.

Another way to indirectly influence waste management is to remove existing subsidies that promote or require the use of virgin materials. For example, substantial Federal tax incentives encourage the use of virgin materials, despite strenuous attempts to remove them from the tax code during the 1986 tax revision. One remaining incentive is the mineral depletion allowance, which allows mineral producers to deduct from 5 to 22 percent of the value of minerals produced when they compute their taxable income from a mineral property.

Whether this option would be effective is uncertain. Data from the 1970s indicate that removing the incentives may not significantly affect secondary materials markets. It may be useful to review the effects of virgin materials subsidies under current economic conditions to determine whether the conclusions of the earlier analyses still hold. Thus, Congress could direct the Departments of Commerce, Interior, Transportation, and Agriculture to analyze the effects of eliminating virgin materials subsidies on the recovery of secondary materials and on the virgin materials industries themselves, including effects on international competitiveness. From this, a more definitive conclusion about the benefits and costs of such subsidies could be drawn.

The effect of the Public Utilities Regulatory Policy Act (PURPA) on the development of waste-to-energy facilities and on recycling also could be considered. PURPA provides for the guaranteed purchase of electricity generated by small, non-utility generators (including, but not limited to, waste-to-energy facilities), at a rate equal to the cost of a utility itself generating that electricity (OTA 1983). That rate, called avoided cost, is determined by each State. Some people consider this to be a form of subsidizing waste-to-energy facilities. Removing this provision, however, will not necessarily result in less incineration and a subsequent increase in recycling. Waste-to-energy facilities could continue

to sell electricity at going rates, sell steam instead, or raise tipping fees to cover losses in revenues.[31] Removing the provision also could harm other co-generators, which might pose problems if the nation's energy picture changes for the worse. The Federal Energy Regulatory Commission is already considering restricting the definition of avoided cost to remove the difference between the going electricity rate and the rate paid to small generators, which would render the issue moot.

Option 6C: Product Charges

Products can be designed to be more easily recycled, a concept termed "design for recyclability." Congress could place a tax on difficult-to-recycle products to provide an incentive for such design.[32] Such a tax, which should be levied on the manufacturer for optimal effect, would have to be large enough to influence product design decisions. The size of the tax required to induce a manufacturer to redesign products will differ for different products.

Option 7: Require Secondary Materials Recovery and Reprocessing

The Federal Government could more aggressively promote secondary materials recovery and reprocessing by the following methods: 1) requiring deposits on recyclable or problematic products; 2) requiring that post-consumer secondary materials be used to the extent technically feasible in place of virgin materials[33]; 3) requiring communities to establish separation programs; 4) banning products that are difficult or impossible to recycle; 5) banning certain materials from landfills or incinerators; and 6) acting as a buyer of last resort and creating a national stockpile of secondary materials.

These options undoubtedly could be used to increase recycling, but all would likely entail significant costs to other sectors of the economy. Mandatory recycling approaches such as these should be undertaken only after clearly understanding the full range of their social and economic costs. For example, mandating that secondary materials be used in manufacturing to the extent technically feasible, regardless of their costs relative to virgin materials, would increase markets for secondary materials but would disrupt markets for virgin materials. The costs to the virgin materials industries should be considered before implementing such a policy. In addition, to ensure that the competitiveness of U.S. industries is not harmed, imported products would have to be subject to similar provisions. Of all these options, only deposit systems have received much scrutiny. For this reason, deposit legislation is discussed here to illustrate the complexities associated with adopting such options.

Deposit Legislation

Proposals for a mandatory deposit system for beverage containers appear before Congress annually, and they are designed to address a variety of issues including litter control and energy conservation (OTA, 1979).[34] National deposit legislation recently has been proposed in Congress as a means to increase the recycling and reuse rates of beverage containers. The nine States which have deposit legislation (figure 7), however, adopted it primarily because of concerns over litter control. In general, beverage container deposit systems capture between 70 and 90 percent of the targeted containers and appear particularly effective in reducing litter (Belasen, 1988). Data reported by several States with deposit systems indicate that total roadside

[31]A tipping fee is the price paid by a waste transporter to have the waste managed at a particular facility.

[32]Some proposals in this option category also would ban certain products. With respect to plastics, for example, one purpose of the bans is to encourage manufacturers to use plastics that can be recycled or will degrade and to use other recyclable materials, or to use plastics that can be incinerated without forming hazardous compounds. It is not clear, however, that substitute materials necessarily will be more compatible with recycling.

[33]A recent move by one EPA Region to include recycling as a condition in a permit for a new incinerator (see "Incineration" below) could signal an additional way for Federal involvement in mandating secondary materials recovery.

[34]Deposits could also be applied to other types of materials in MSW, for example, car batteries and tires. These deposits could be incorporated into the price of a new car, as well as into the cost of replacement batteries and tires.

litter decreased between 15 and 50 percent, and beverage container litter decreased by as much as 80 percent (Rozett, 1984; Golub et al, 1985). The impact on the MSW stream, however, is less certain, and its calculation is problematic. New York State estimates that since adoption of their Returnable Beverage Container Law, a Statewide savings of 5 to 8 percent in landfill space has resulted (Golub et al, 1985). Critics of mandatory deposit legislation point out that it has a relatively small impact on MSW disposal problems, given that beverage containers are a small, albeit highly visible, portion of the MSW stream.[35] Curbside programs to collect recyclables can cover a broader portion of MSW and thus have the potential to achieve greater diversion of materials from landfills. In the past, deposit legislation may have stimulated the development of processing facilities and recycling markets, but curbside and other types of recycling programs also have this potential.

One major concern about deposit systems has been the potential to increase costs to consumers, retailers, the beverage industry, and the government. The extent of such increases is disputed (Rose 1982/83; Lesser and Madhavan 1987; Porter 1983). It appears overall, however, that both the benefits and costs of deposit systems are considerable and not out of proportion to each other (Porter 1983; Rozett 1984; Moore and Scott 1983). Studies generally indicate a net gain of jobs and some energy and resource savings, but the rate of price increases for beverages in nonrefillable containers is above normal inflation. Costs for changing over to a system for returnable/refillable containers might be high for the beverage industry, but could be at least partially recovered within a few years (Moore and Scott, 1983; Rozett, 1984). Deposit systems also can internalize the disposal cost of beverage products, as can curbside collection programs.

In some States with deposit legislation, such as New York, Massachusetts, and Connecticut, curbside collection programs also are being adopted. California and Florida have adopted modified versions of mandatory deposit or redemption legislation.[36] In 1987, California enacted a redemption law for beverage containers that mandates the establishment of "convenience" buy-back centers for recycling. Yet the financial stability of the convenience centers, administrative burdens associated with implementing the program, and other difficulties are creating concern over the viability of this approach.

In 1988, Florida adopted a deposit-fee system that affects all types of containers, not just beverage containers. As of October 1, 1992, a disposal fee of one cent will be levied on any container sold at retail which is not recycled at a 50 percent rate in Florida. The fee will increase to two cents if the 50 percent target is not met by October 1, 1995. The inclusive scope of materials covered by the Florida law is generally viewed positively, but it is too soon to judge how easily this program will be implemented.

Proponents of mandatory deposit systems argue that statewide or nationwide consistency is desirable, that the costs of disposal are internalized on the industry and consumers (rather than to all taxpayers), and that deposits could be used for a variety of purposes (e.g., managing particularly difficult-to-dispose-of items). However, States are independently devising programs to encourage recovery of materials from MSW, including deposit, redemption, and/or mandatory recycling programs, as appears most appropriate for their particular circumstances. In this light and in the interest of

[35]Beverage containers overall constitute 6 to 11 percent of MSW on a national basis. Most deposit legislation covers a smaller portion of MSW, approximately 5 percent, because some types of containers are not included (e.g., for wine, liquor, and milk).

[36]It is not clear whether recycling programs are negatively affected in States which adopt a deposit or redemption law (e.g., California), or whether the adoption of mandatory recycling in States which already have deposit laws (e.g., New York) is detrimental to overall effectiveness of waste management.

maintaining flexibility at the Federal level with respect to recycling strategies, it is not clear whether it is desirable at this time for Congress to adopt national deposit legislation or any other single approach to encourage materials recovery and recycling.

Incineration

The role of incineration is one of the most contentious issues in MSW management. Public opposition to incineration has grown dramatically in many communities because of concerns about the presence of metals and undesired chemicals in emissions and in the ash residues. In addition, incinerators often are expensive for municipalities, and the potential for stricter regulations on air emissions and ash disposal will increase both the financial risk and cost of new incinerators. These factors have caused some cities to postpone or cancel plans for incinerators.

At the same time, however, incineration is attractive because it treats MSW (e.g., destroys pathogens), can be adapted to recover energy, and greatly decreases the amount of material that must be landfilled. Also, newer facilities that use up-to-date operating procedures and pollution control technologies are capable of emitting much lower concentrations of pollutants into the atmosphere than are older facilities. This abatement of air pollutants, however, puts more pollutants in the remaining ash; as a result, some environmental groups contend that certain forms of ash should be managed as hazardous wastes.[37]

A national policy based on prevention and materials management would promote opportunities to reduce the concentrations of pollutants in emissions and ash. If the strategies outlined in this report were implemented, products in MSW would ideally be composed of fewer toxic substances, and non-combustible materials such as glass or metals would be separated for recycling and/or landfilling and would not enter furnaces. Yard wastes would also be separated for composting, which would alleviate problems with moisture control and nitrogen oxide emissions at incinerators. Communities could then use incineration and energy recovery to manage some of the non-recyclable portions of MSW, and possibly to manage materials collected for recycling when markets for those materials are depressed.

The use of incineration may increase during the next few decades, but to what extent is very unclear. Over 160 MSW incinerators (including about 120 waste-to-energy facilities) now combust about 10 percent to 12 percent (by weight) of the MSW generated in the United States; about one-fourth of this remains as ash that must be managed in other ways (primarily disposed of at landfills). About 45 facilities were under construction as of spring 1989, and plans to build additional facilities have been negotiated in some communities. If all of these are actually built, the portion of MSW that would be managed at incinerators is estimated to increase to about 25 percent by the end of the century (including the remaining ash).

Nevertheless, it is not clear how much new incinerator capacity will actually be developed. There is evidence that the rate at which plans for increased incineration capacity are being canceled is greater than the rate at which new capacity is actually being developed. In addition, the costs of future facilities will depend on what pollution controls and operating procedures are required by permitting authorities. Some States have issued specific regulations for incinerator emissions and ash, but these regulations vary widely. A few Federal regulations apply to emissions (e.g., for particulate matter; in addition, "New Source Review" and "Prevention of Significant Deterioration" evaluations are conducted by the States under the provisions of the Clean Air Act), but MSW incinerators

[37]The uncertainties about ash (e.g., whether it is worse than non-incinerated waste, how much it contributes to leachate problems) cannot be resolved easily with current information, yet there are some decisions that can be made about managing ash that do not require final resolution of the uncertainties.

generally are not subject to Federal regulation. EPA is scheduled to propose regulations concerning emissions in late 1989, but it will not propose guidelines or regulations for ash management until Congress clarifies whether or not ash should be managed as a hazardous waste.

Thus, considerable uncertainty exists about what will be required in the future. There is a general consensus that Federal regulations should be finalized as soon as possible to help reduce this uncertainty. This would provide: 1) a consistent national guideline for the development of new facilities; 2) greater assurance to the public that the risks associated with incinerators are being properly controlled; and 3) a rationale for local and State officials to require particular designs and pollution controls. There is, however, debate about how emissions and particularly ash should be regulated. Two issues related to incineration are capacity and siting (see "Ensuring Capacity" above) and the relationship between incineration and recycling.

Option 1: Clarify Ash Management

The first issue that needs to be resolved is whether the "household waste exclusion" applies to ash. This refers to a provision in the 1984 Hazardous and Solid Waste Act amendments (Section 3001(i)), in which waste-to-energy facilities that burn MSW were exempted from regulation as hazardous waste treatment facilities. However, Congress did not clarify whether the ash from these facilities also was exempt from regulation as a hazardous waste. As a result, confusion exists over whether this ash should be managed as a hazardous waste if it fails a standard toxicity test known as the Extraction Procedure, or EP, test. EPA has stated that it will not propose guidelines for ash management until Congress clarifies this issue.

A second issue to be addressed is the lack of guidance on the design and operating standards that Subtitle D facilities (i.e., facilities for managing nonhazardous wastes) should meet for managing ash if and when ash is considered nonhazardous.

Option 1A: Clarify the Household Waste Exclusion

Congress should clarify the "household waste exclusion." If Congress decides that the exclusion *does* apply, then managing ash of any type as a hazardous waste under Subtitle C would be out of the question.[38] If the exclusion *does not* apply, then EPA or Congress needs to specify those conditions under which ash should be managed as a hazardous waste. Congress, for example, could decide whether to *list* fly ash as hazardous, or to use toxicity *testing* as the basis for deciding whether ash should be managed as hazardous.

Listing.—Congress could direct EPA to list fly ash as a hazardous waste because fly ash samples generally fail the EP test. This would eliminate the need for testing. The costs of managing fly ash as a hazardous waste will be more than current costs, although by how much is uncertain. Another uncertainty is whether there is any difference in potential human health risks associated with managing fly ash in a Subtitle C hazardous waste facility, as opposed to a double-lined Subtitle D facility, or even as opposed to managing combined ash in a single-lined Subtitle D monofill.[39]

Testing.—Alternatively, periodic testing could be required and any ash that fails the EP test (or an equivalent) would then be managed as a hazardous waste. This would raise several problems, however. First, there is considerable controversy about the utility of the EP test, and

[38]The two basic types of ash are **fly** ash, which consists of the small particles that become entrained in gases leaving the furnace, and **bottom** ash, which is the uncombusted or partly combusted residue that accumulates on the bottom of the furnace. When fly and bottom ash are mixed together, the mixture is called **combined** ash. In this report, use of the word "ash" without one of these three qualifying terms refers to any type of ash.

[39]These facilities differ in the degree to which they provide control over leachate. Facilities with single liners, for example, generally are considered to provide less control than facilities with double liners.

it is not clear whether an acceptable alternative test can be developed. Second, EPA's proposal to lower the maximum contaminant level (MCL) for lead in drinking water (53 *Federal Register* 31516, Aug. 18, 1988) would lower the corresponding limits for lead in EP tests, which in turn means that more ash would test as hazardous.

Option 1B: Decide How to Manage Ash Under Subtitle D

Little guidance exists on the design and operating standards that Subtitle D facilities should meet for ash management. EPA's proposed Subtitle D criteria do not address ash management in detail, and EPA has not indicated whether, and especially when, it might develop specific regulations for ash. Most States have not addressed this issue. As a result, Congress could decide how ash should be managed, in particular whether the standards to be met should depend on the type of ash involved or on the results of toxicity testing. Whether to allow co-disposal of ash with MSW must also be decided.

Specify Facility Standards According to Ash Type.—One approach to ash management is to specify different design and operating standards for facilities that handle different types of ash. This would avoid problems associated with managing ash based on test results and provide an easy basis for management decisions. For example, fly ash might be managed in a facility with double-liners and double leachate detection/collection systems. This would provide about the same control over fly ash as would management in hazardous waste facilities, but whether it would lower costs is unclear. In addition, standards could be developed for situations in which ash could be used (e.g., in construction materials). The primary drawback of this approach is its lack of flexibility in cases where characteristics of the ash (e.g., variability in leaching potential) or the facility itself (e.g., great distance from groundwater) might make the specified controls unnecessary.

Specify Facility Standards Based on Test Results.—Alternatively, toxicity test results could be used to indicate the type of facility necessary to manage the type of ash. For example, any ash that failed the test might be managed at facilities with double liners and double leachate detection/collection systems. Untreated ash that passed the test might be managed at facilities with single liners and leachate systems.[40] Treated ash that passed the test might be co-disposed with MSW. Conditions under which exclusions were acceptable (e.g., certain site characteristics) also could be determined. This approach would manage ash on an environmental basis (i.e., its potential to leach metals into groundwater). The related problems are the same as those noted above—unreliable tests, the effect of changes in MCLs, and the extra expense of frequent testing. In addition, facility operators will face the uncertainty of not knowing what type of management will be required, even though they often need or want to know what will happen to the ash before a facility is built.

Should Co-Disposal With MSW Be Allowed?—EPA's proposed Subtitle D regulations would not prohibit co-disposal of untreated ash and MSW. The chances of mobilizing metals from untreated ash will almost always be greater in co-disposal situations than in monofill situations, although whether this will always lead to levels of regulatory concern is unknown. As a result, it makes sense to keep *untreated* ash and MSW separate. Whether co-disposal with treated ash should be allowed is uncertain. Treatment technologies appear promising, but additional research on long-term performance is required. Congress could require EPA to sponsor more research on treatment and address this issue in ash management regulations.

[40]After ash is collected (either from the grate or from air pollution controls), it usually is left untreated (i.e., not subjected to any additional special treatment). It can be treated, however, with chemical or thermal processes to make it safer to dispose of or reuse.

Option 2: Clarify the Regulation of Emissions

Although emissions are less controversial than ash management, the only Federal regulations that apply to emissions from MSW incinerators are those that apply to all sources of emissions (e.g., for particulate matter and mercury). Specific performance standards for new MSW incinerators and guidelines for existing incinerators are scheduled to be proposed by EPA in November 1989, but they would not become effective until 1991 at the earliest. Congress could give additional direction to EPA by specifying: 1) whether to base standards on the best available control technologies or on risks; and 2) when, and to what level, to require retrofitting of older facilities.

Option 2A: Choose Standards Based on BACT or on Risks

EPA is regulating new facilities on the basis of guidelines that require the use of best available control technologies (BACT) to control emissions in the interim before it promulgates final emissions regulations. Currently-accepted BACT (e.g., scrubbers, particulate controls such as baghouses or electrostatic precipitators, automatic combustion processes) can enhance the performance of new incinerators and provide much greater control than did previous technologies. It also allows some flexibility in deciding which combination of technologies to use. Congress could allow EPA to continue on this course, either by not addressing this issue or by statutorily defining the use of BACT.

A recent recommendation by EPA Region 10 regarding a permit for a new incinerator in Spokane, Washington, could have significant implications for the definition of BACT, if the recommendation is implemented (EPA, 1989 memo). The recommendation, made in response to opposition from several citizen groups, would include pre-combustion requirements for source separation and recycling as part of the BACT provisions in the permit. This would mark the first time such a linkage between recycling and incineration has been made in a permit. The local solid waste agency has opposed including these provisions in the permit itself, contending that receipt of construction funding from the State already is linked to development of a recycling program, and that the agency already plans to develop a drop-off and curbside recycling program with a 45 percent recycling goal (Env. Rep., April 1989). This situation is a good example of both the opportunities and difficulties of implementing the materials management concepts at the local level.

Whether BACT is sufficient to meet public concerns about potential risks, however, probably will vary from area to area. Some people would like standards to be based on risk, to provide more stringent protection than current BACT. Requiring EPA to develop risk-based standards might help build public confidence and aid in the siting process. On the other hand, a strictly risk-based approach has several disadvantages, including: whether adequate technologies are available to achieve the desired protection, the additional costs of using such technologies, and the uncertainties inherent in risk assessment methodologies and results. The risk-based approach also could lead to fewer controls, depending on circumstances.

Another alternative is to promulgate regulations that require BACT, but that also allow additional, risk-based controls in specific situations. This approach would be similar to that of EPA's water program, which uses standards based on best available technologies and, where indicated by risk-based toxicity testing, additional controls (OTA 1987). It also implies that minimum, as opposed to uniform, regulations would be needed. No matter what form emissions regulations take, they probably will bring higher prices to the municipal users of such facilities. This can be considered as one way of internalizing waste management costs.

A related issue is whether standards should be minimum or uniform. Minimum standards allow States to impose additional and possibly more stringent limitations, which provides the States with the flexibility to respond to specific conditions within their jurisdictions. Uniform standards would mean that the same standards and testing procedures apply to all situations. This would simplify the regulatory process and reduce the number of different tests that companies have to perform to satisfy different State testing requirements. However, it means that States would not have the power to impose additional limitations if they felt Federal standards were not sufficient to protect public health. It is likely that EPA will use the minimum standards approach in its regulatory proposals.

Congress also could require that EPA develop guidelines for training incinerator operators to help ensure greater efficiency and safety. EPA could base these guidelines on the efforts of the American Society of Mechanical Engineers (ASME), which is developing a model training and certification program (EPA, 1989). Congress also could direct EPA to increase its research on the technical and economic feasibility of new emissions control systems and improved monitoring methods (e.g., continuous emissions monitoring methods).

Option 2B: Establish Policies Regarding Existing Incinerators

With respect to retrofitting existing incinerators, Congress could decide whether all old facilities should be required to retrofit, no matter what the cost, or whether some or all should be exempted under certain conditions. If one objective is to reduce potential risks to human health and the environment, old facilities should be required to eventually meet the same or similar standards as new facilities. In some cases, improvements can be achieved with relatively small changes in operating procedures (e.g., computerizing controls, increasing operator training). In other cases, however, retrofitting will involve adding pollution controls (e.g., scrubbers, baghouses). This can be expensive and could lead to some facilities closing, which might reduce risks but would also affect available waste management capacity. One factor that could be considered is the appropriate age of existing plants for which to require retrofitting. Retrofitting may be important, for example, for facilities that have been operating for 5 or more years but that do not meet current BACT standards and are scheduled to continue operating for at least an additional 5 years. For facilities nearing the end of their projected lifetime, retrofitting may not be worthwhile.

Congress could consider innovative means to finance the retrofitting of existing facilities. For example, the Massachusetts Solid Waste Act requires each facility operator to set aside 3 percent of all tipping fee revenues into a dedicated fund that will be used to meet future State pollution control requirements (Mass. DEQE, 1988). Congress could adopt this approach for existing, and perhaps new incinerators, by requiring that a similar provision be included in permit renewals and in new permits.

Landfills

Landfills will always be needed to manage the residues from recycling and incineration, as well as for the non-combustible, non-recyclable portion of the waste stream. Indeed, a continued high percentage of all MSW could be landfilled if the Nation were willing to site or expand more landfills, pay the costs of transporting MSW to these landfills, pay for pollution controls, and accept some unavoidable risks. Some new landfills are being sited, and permitted capacity at existing landfills has been expanded in some cases.[41] In some localities, landfills will remain the primary management method, especially

[41]Landfills must have permits to operate legally; some facilities may have additional space that is not permitted, but such space is not considered to be available capacity.

where recycling and/or incineration capacities cannot be developed economically, or where landfills can be located away from aquifers (e.g., in some arid areas).

Overall, the current decline in permitted landfill capacity seems likely to continue. *Increased landfill capacity cannot be relied on as a nationwide solution to MSW problems, given current attitudes about siting and desires to move toward prevention and other forms of management.*

Implementing a prevention and materials management policy could reduce some associated risks and prolong the life of some landfills. For example, much of the MSW in landfills consists of paper and paper products, yard and food wastes, and plastics.[42] Thus, separating and composting yard waste could divert a large portion of MSW from landfills and reduce some potential leachate problems. Moreover, new landfills that use BACT (e.g., synthetic liners, leachate collection systems) and proper siting procedures can be managed much more safely than could past landfills.

The issues raised by landfilling thus are similar to those for incineration. Two of these issues, the Federal role in resolving siting problems and developing capacity, were discussed above. The primary issue discussed here is how to ensure that new and existing facilities provide adequate public health and environmental protection. Most States have some guidelines or standards for MSW landfills, in some cases based on criteria developed by EPA in 1979, and many older, substandard landfills have closed instead of being upgraded to meet these standards. EPA is revising recently proposed regulations for the design, operation, and location of Subtitle D landfills. Congress could provide additional direction to EPA, particularly guidance on whether the regulations should use a risk-based or design-based approach and whether they should apply to facilities that close before the standards become effective. Congress also could clarify the issue of municipal liability for corrective action.

Option 1: Give Additional Direction to EPA's Regulatory Effort

Option 1A: Specify How Landfills Should Be Regulated

The regulations currently proposed by EPA do not require the use of BACT. Instead, they would allow States to regulate each aquifer with a different risk-based standard, so long as the associated cancer risk fell below a specified range. Depending on the risk level chosen for a given site, some new landfills might be built without liners or leachate collection systems. This flexibility may be desirable, but the range of allowable risks is wide (between one additional cancer death per 10,000 people and one per 10,000,000 people), and EPA provided little guidance on which design features would meet particular risk-based standards.

Congress could endorse this risk-based approach, or it could direct EPA to specify uniform design criteria based on BACT, and thus provide clearer direction to communities and States about how new landfills should be built. The major problem with a design-based approach is its lack of flexibility, particularly for sites located in arid areas, far from an aquifer, or in special geological areas. This problem could be addressed, however. For instance, site-specific variances from uniform criteria could be allowed, assuming that the alternative provides a similar level of protection. Alternatively, EPA could specify different design features for use in different situations, although this might prove to be a formidable task given the variability in site characteristics.

[42]These materials represent about two-thirds by weight of the waste in landfills. OTA cannot be specific about the average total volume that these materials comprise because data are lacking on the composition by volume of MSW entering landfills.

Option 1B: Extend Corrective Action and Closure Requirements

Some MSW landfills have been associated with environmental problems (e.g., groundwater contamination), and it is possible that more will cause problems in the future. EPA's proposed regulations include corrective action, closure, post closure, and financial assurance requirements to help remedy future problems. Existing landfills that close within 18 months after the regulations are promulgated, however, would not be subject to the corrective action requirements unless State regulations require otherwise. As a result, the rate at which substandard facilities close is likely to increase because they could avoid potentially expensive closure and corrective action procedures. Congress could address this issue by directing EPA to consider making all existing landfills subject to the requirements at the time the regulations are promulgated. While this would impose substantial costs on some landfill operators, it would provide for the orderly closing of substandard facilities and avoid some of the problems discussed in Option 2 below.

Option 2: Clarify Municipal Liability Provisions

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, commonly known as Superfund) currently can be used for remedial actions at landfills, and indeed 20 percent of the sites on the National Priorities List (NPL) are municipal landfills.[43] Although local governments do not relish the idea of having their landfill on the NPL, Superfund does provide two advantages to municipalities—a source of funding for cleanup, and the sharing of liabilities for cleanup and corrective action among industrial waste generators, transporters, and local owners and operators.

In proposed amendments to CERCLA, however, EPA suggested deferring the listing of additional municipal landfills on the NPL after corrective action requirements under subtitle D of RCRA are issued (53 *Federal Register* 51394, Dec. 21, 1988). This deferral policy would apply only to currently active landfills, not to previously closed ones. It would require that active landfills meet financial responsibility requirements for cleanup to assure some funding for remediation efforts that do not fall under Superfund.

One important consequence of this proposed policy, however, is that it would make local landfill owners and operators liable for corrective action and cleanup costs, instead of sharing liability with waste generators and haulers.[44] This policy is supported by representatives of industrial waste generators, who contend that MSW alone can generate toxic leachate and that corrective action at municipal landfills should be handled under a separate program (Webster 1988).

The disadvantage to municipalities is that the costs of identifying, ranking, and cleaning up Superfund-type sites are high (OTA 1985, 1989), and few municipalities are likely to be able to bear such costs. Moreover, most municipalities have either expected to share liabilities with waste generators and transporters or been unaware of their liabilities under Superfund. The position of organizations representing municipalities (e.g., National League of Cities, Governmental Refuse Collection and Disposal Association) is that Superfund should continue to be used for corrective action and cleanup of municipal landfills (Steinzor 1989).

Congress could allow EPA to continue developing the deferred listing policy, in conjunction with development of corrective action requirements under proposed Subtitle D criteria. If

[43]The NPL is the list of sites designated by EPA for cleanup action under the auspices of the Superfund program.

[44]At least initially, this would be true. In theory, however, the costs could later be recovered through legal action against waste generators, but some argue that in practice this would be unlikely (Steinzor 1989).

Superfund is not used for cleanup of additional municipal landfills, one possibility for easing the financial burden on municipalities is for States to place a tax on tipping fees at all landfills. Revenues could be placed into trust funds to support corrective action programs. This approach is being tried in some States (e.g., Massachusetts).

Alternatively, Congress could direct EPA to revise the proposed amendments, specifically to continue including municipal landfills in Superfund. Another alternative is to allow States to petition EPA to defer individual sites. In this approach, site-specific conditions would be considered and the deferred site would be handled under other programs. The position of the municipal representatives on this approach is that, if it is adopted, States should be required to obtain the concurrence of the local government owner and operator when a municipal site is considered for deferral.

A longer-term approach to avoiding such problems is to keep certain materials out of landfills. For example, localities could be encouraged to remove and compost yard wastes, which would reduce the probability that leachate will cause problems. Some States have banned the disposal of such materials in MSW landfills if composting facilities are available. The disposal of industrial wastes and small quantity generator hazardous wastes at MSW landfills also could be phased out as other management capacity for these wastes is developed. In the interim, landfill operators could be required to meet stricter standards and provide better records if they accept such wastes.

REFERENCES

Aluminum Association, personal communication, B. Meyer, 1989.

American Paper Institute, *1987 Annual Statistical Summary, Waste Paper Utilization*, June 1988.

Ayers, R.U., and A.V. Kneese, "Production, Consumption, and Externalities," *American Economic Review*, June 1969 (available from Resources for the Future, reprint #76).

Belasen, A.T., *The New York State Returnable Beverage Container Law—Economic Effects, Industry Adaptations, and Guidelines for Improved Environmental Policy*, Rockefeller Institute Working Papers No. 31 (Albany: State University of New York, Spring 1988).

Berkman, M.P., and F.C. Dunbar, "The Underpricing of Landfills," paper presented at Third Annual Conference on Solid Waste Management and Materials Policy (New York: Feb. 13, 1987).

Center for the Biology of Natural Systems, *Development and Pilot Test of an Intensive Municipal Solid Waste Recycling System for the Town of East Hampton*, report submitted to New York State Energy Research and Development Authority (Flushing, NY: 1988).

Clean Japan Center, "Waste Volume on the Rise and Measures Against It," *Clean Japan* 14:6-10, February 1989.

Copperthite, K., U.S. Dept. of Commerce, personal communication, 1989.

Crew, M.A., and P.R. Kleindorfer, "Landfill Tipping Fees Should be Much Higher," *Waste Age*, pp. 131-134, February 1988.

Deutsches Institut für Gutesicherung und Kennzeichnung, "Verzeichnis der Produkte und Zeichenanwender sowie der jeweiligen Produktanforderungen" (Bonn: June 1988).

Dunbar, F.C., and M.P. Berkman, "Sanitary Landfills are Too Cheap!" *Waste Age*, pp. 91-99, May 1987.

Environment, "Environmentally Friendly Products," *Environment* 31(2):23, 1989.

Environment Reporter, "EPA Region X Calls for Recycling as Possible Incinerator Permit Condition," *Environment Reporter* 19(49):2565-2566, April 7, 1989.

Environmental Defense Fund, "National Advertising Campaign on Recycling Launched by the Environmental Defense Fund & the Advertising Council," news release (New York: Sept. 15, 1988).

Ferrand, T., "Memorandum, Proposed NRC Standard Definitions" (Absecon, NJ: Ferrand Associates, Nov. 16, 1988).

Franklin Associates, Ltd., *Characterization of Products Containing Lead and Cadmium in Municipal Solid Waste in the United States, 1970 to 2000, Executive Summary and Chapter 1*, Final report prepared for U.S. EPA, Municipal Solid Waste Program (Prairie Village, KS: January 1989).

Franklin Associates, Ltd., *Characterization of Municipal Solid Waste in the United States, 1960 to 2000 (Update 1988)*, Final report prepared for U.S. EPA (Prairie Village, KS: March 1988).

Golub, N.M., J.R. Strachan, P.A. Berle, et al, *Final Report of the Temporary State Commission on Returnable Beverage Containers* (Albany, NY: March 27, 1985).

Greenblott, J., Technical Resources, Inc., pers. comm., Sept. 1988.

Hemphill, T., "Financing Options: The Next Phase of Market Development," *Recycling Today* 26(12):58-66, Dec. 1988.

Institute for Local Self-Reliance (ILSR), "National Recycling Research Agenda Project," Final Report to National Science Foundation (Washington, DC: 1980).

Institute for Local Self-Reliance (ILSR), *Financing Mechanisms to Promote Recycling at the State and Local Level* (Washington, DC: 1985).

Institute for Local Self-Reliance (ILSR), *Beyond 25 Percent: Materials Recovery Comes of Age* (Washington, DC: 1989).

Kneese, A.V., and B.T. Bower, *Environmental Quality and Residuals Management* (Johns Hopkins Univ. Press, Baltimore: 1979).

Kovacs, W.L., "The Coming Era of Conservation and Industrial Utilization of Recyclable Materials," *Ecology Law Quarterly* 15:537-625, 1988.

Kovacs, W.L., and A.A. Anderson, "States As Market Participants in Solid Waste Disposal Services—Fair Competition or the Destruction of the Private Sector?" *Environmental Law* 18:779-816, 1988.

Lesser, W., and A. Madhavan, "Economic Impacts of a National Deposit Law: Cost Estimates and Policy Questions," *Journ. Consumer Affairs* 21(1):122-140, Summer 1987.

Massachusetts Department of Environmental Quality Engineering, "Q&A, Questions & Answers on the Solid Waste Act of 1987," Division of Solid Waste Management (Boston: Jan. 1988).

McCarthy, J., Congressional Research Service, pers. comm., Feb. 1989.

Moore, W.K., and D.L. Scott, "Beverage Container Deposit Laws: A Survey of the Issues and Results," *Journ. Consumer Affairs* 17(1):57-80, Summer 1983.

Obermeier, T., Federal Republic of Germany, pers. comm., March 1989

Oregon Department of Environmental Quality, "An Evaluation of the True Costs of Sanitary Landfills for the Disposal of Municipal Solid Waste in the Portland Metropolitan Area," prepared by ECO Northwest (April 1986).

Porter, R.C., "Michigan's Experience with Mandatory Deposits on Beverage Containers," *Land Economics* 59(2):177-194, May 1983.

Rathje, W.L., W.W. Hughes, G. Archer, and D.C. Wilson, "Source Reduction and Landfill Myths," paper presented at ASTSWMO National Solid Waste Forum on Integrated Municipal Waste Management (Lake Buena Vista, FL: July 17-20, 1988).

Rathje, W.L., University of Arizona, pers. comm., Feb. 1989.

Riggle, D., "Only Pay For What You Throw Away," *BioCycle* 30(2):39-41, February 1989.

Rose, D., "National Beverage Container Deposit Legislation: A Cost-Benefit Analysis," *J. Environmental Systems* 12(1):71-84, 1982-83.

Rozett, J.M., "Resolving the "Bottle Bill" Controversy: The Role of Policy Analysis in Decision Making," Rockefeller Institute of Government, New York Case Studies in Public Management Number 14 (Albany: State University of New York, Nov. 1984).

Society of Packaging and Handling Engineers, "Memorandum Re: SPHE Recycling and Disposal Guidelines for Packaging Professionals" (Reston, VA: July 11, 1988).

Steel Can Recycling Institute, personal communication, K. Smallburg, 1989.

Steinzor, R.I., "Comments of the National League of Cities and the Governmental Refuse Collection and Disposal Association on EPA's Proposed Revisions to the Superfund National Contingency Plan" (Washington, D.C.: Spiegel & McDiarmid, March 23, 1989). Society of the Plastics Industry, personal communication, 1988.

U.S. Congress, Office of Technology Assessment, *Materials and Energy From Municipal Waste*, OTA-M-93 (Springfield, VA: National Technical Information Service, July 1979).

U.S. Congress, Office of Technology Assessment, *Industrial and Commercial Cogeneration*, OTA-E-192 (Springfield, VA: National Technical Information Service, February 1983).

U.S. Congress, Office of Technology Assessment, *Technologies and Management Strategies for Hazardous Waste Control*, OTA-M-196 (Springfield, VA: National Technical Information Service, March 1983).

U.S. Congress, Office of Technology Assessment, *Superfund Strategy*, OTA-ITE-252 (Springfield, VA: National Technical Information Service, April 1985).

U.S. Congress, Office of Technology Assessment, *Serious Reduction of Hazardous Waste*, OTA-ITE-317 (Springfield, VA: National Technical Information Service, September 1986).

U.S. Congress, Office of Technology Assessment, *From Pollution to Prevention: A Progress Report on Waste Reduction*, OTA-ITE-347 (Washington, DC: U.S. Government Printing Office, June 1987).

U.S. Congress, Office of Technology Assessment, *Wastes in Marine Environments*, OTA-O-334 (Washington, DC: U.S. Government Printing Office, April 1988).

U.S. Congress, Office of Technology Assessment, "Workshop on MSW Reduction" (Washington, DC: July 14-15, 1988).

U.S. Congress, Office of Technology Assessment, *Issues in Medical Waste Management*, OTA-BP-O-49 (Wash-

ington, DC: U.S. Government Printing Office, October 1988).

U.S. Congress, Office of Technology Assessment, *Assessing Contractor Use in Superfund-Background Paper*, BP-ITE-51 (Washington, DC: U.S. Government Printing Office, January 1989).

U.S. Environmental Protection Agency, *Report to Congress, Solid Waste Disposal in the United States, Volume II*, Office of Solid Waste and Emergency Response, EPA/530-SW-88-011B (Washington, DC: October 1988).

U.S. Environmental Protection Agency, *The Solid Waste Dilemma, An Agenda For Action*, Report of the Municipal Solid Waste Task Force, Office of Solid Waste (Washington, DC: February 1989).

U.S. Environmental Protection Agency, "Spokane Regional Waste to Energy Project PSD Appeal No. 88-12 (Spokane, Washington)," Memorandum from G. O'Neal, Air and Toxics Division, to R.L. McCallum, Chief Judicial Officer, EPA Region X (Seattle, WA: 1989).

Water Pollution Control Federation, "Waste Minimization and Waste Reduction," *Journ. Water Poll. Control Fed.* 61(2):184, 1989.

Webster, I., "Municipal Solid Waste Landfills: Toxic Chemical Releases and the Role of Industrial Wastes in Those Releases," unpublished manuscript (Los Angeles: Unocal Corp., 1988).

Worldwatch Institute, "Environmental Seal of Approval," *WorldWatch* 2(3):6-7, May/June 1989.

Box 1-A—MSW DEFINITION AND DATA NEEDS

Municipal solid waste (MSW) is solid waste generated at residences, commercial establishments (e.g., offices, retail shops, restaurants), and institutions (e.g., hospitals and schools). This waste may be categorized as materials (e.g., glass, paper) or products (e.g., appliances, containers, tires). For purposes of this report, MSW does *not* include construction or demolition debris or automobile scrap.

Solid waste is defined in RCRA (Section 1004 (27)) as "any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities . . ."

ESTIMATES OF MSW GENERATION

EPA has estimated that total MSW generation in the U.S. is over 160 million tons in 1986, and that it is rising at a rate of about 1 percent each year. These estimates are based on a materials flow model (referred to here as the EPA/Franklin model). Figure 1 shows the model's estimates of the composition of MSW by weight, in terms of different materials and products.

Most of the increase in the generation rate is attributable to population growth. However, each person also appears to be generating more waste on average. The EPA/Franklin model estimates that each person in the United States generated 3.6 pounds of garbage per day in 1986; this is expected to grow to 3.8 pounds by 2000.

Determining actual MSW generation rates is difficult. Some evidence indicates that the average generation rate per person may be higher than the model's estimates. Different studies report widely different rates, and use different definitions. For example, it often is not clear whether industrial waste and demolition debris are included in calculations.[1] This lack of consistent definitions and procedures for measuring, calculating, or reporting MSW data makes it difficult to aggregate existing local and State data or to compare them with the EPA/Franklin estimates.

Problems caused by inconsistent definitions and data collection techniques also make it difficult to compare generation rates among countries. It is often stated that the United States produces more MSW per person than do other industrialized countries. This may be true—after all, the United States has high rate of purchasing products—but the magnitude of such differences cannot be reliably estimated with current data.

National estimates of total MSW generation in the United States also are not particularly useful for local decisionmaking. *From a local perspective, information about the generation and composition of MSW in local communities is much more critical for making decisions about capacity needs and management options.* For example, overall generation in a given area affects what size of landfill or incinerator is needed; the types of products and materials in the MSW influence planning for recovery of materials for recycling; and variations in composition can affect incinerator design.

DATA AND RESEARCH GAPS

Underlying Factors.—Many potentially important underlying factors that affect MSW generation have not been investigated extensively. Few studies have looked at how degree of urbanization, socioeconomic status, or family size affect generation and composition. Little has been done to document trends in the production of single-use, disposable items, or to document the relative contributions from the residential, commercial, and institutional sectors. Without more detailed analyses of such factors, it will be difficult to focus educational efforts to change consumption patterns and reduce MSW generation rates.

Weight and Volume.—Better data on the weight of MSW components are needed to make decisions about recycling and incineration. For example, prices for secondary materials are usually quoted on a weight basis, so officials who have data on individual components can estimate potential revenues. On a national basis, the largest categories of MSW by weight are estimated to be paper products, yard waste, and food waste.

Date on volume tend to be useful for evaluating landfill capacity, collection vehicle capacity, and the feasibility of quantity reduction. *Unfortunately, most studies have not gathered data on the volumes of different materials in MSW prior to disposal.* Excavation studies at several landfills have provided some data on MSW volume after it has been landfilled for several years; these excavations show that paper and plastics are the largest components by volume.

Calculating Recycling Rates.—Calculating recycling rates for the Nation is also problematic. EPA's estimate that about 10 percent of MSW is recycled excludes materials and products such as demolition debris and automobiles. Some observers contend that these should be included, which would raise the overall recycling rate

considerably. For example, approximately 12 million tons of steel were recycled from automobiles in 1983; this would almost double the EPA/Franklin estimate of tonnage recycled.

Some observers also suggest that recycling "new" industrial scrap should be included in calculations of MSW recycling. However, while scrap may be recycled at the same facilities that recycle secondary materials recovered from MSW, it does not comprise MSW and should not be used to indicate higher MSW recycling rates.

[1]For example, industrial waste might make up 10 percent or more of all waste received at MSW landfills. As new regulations (under RCRA) regarding the on-site management of industrial wastes become more stringent, it is possible that industrial disposal at MSW landfills may increase.

Box 1-B—THE RESOURCE CONSERVATION AND RECOVERY ACT

The Resource Conservation and Recovery Act (RCRA) is the major Federal statutory authority addressing solid waste, including MSW.[1] Key provisions of RCRA are described here, but it should be noted that many of these programs were not implemented or have not been functional since the early 1980s.

A major focus of Subtitle D (Subchapter IV of RCRA) is to encourage the *development of State solid waste management plans* and to foster intergovernmental (Federal, State, and local) and public/private cooperation (Section 4001). Federal technical and financial assistance are offered to States and localities as incentives for them to develop plans (Sections 4002-4003, Sections 4006-4008).

In 1984, the Hazardous and Solid Waste Amendments (HSWA) to RCRA added a method for EPA to encourage *compliance of State plans with Federal guidelines*. Specifically, EPA may use its enforcement powers under the hazardous waste provisions of RCRA if a State fails to implement permit programs for solid waste facilities receiving hazardous wastes from small quantity generators and/or household hazardous wastes (Section 4005(c); see also Section 3001(d)).

Another major focus of Subtitle D is *the improvement of landfills*.[2] EPA is authorized to promulgate regulations containing criteria to classify types of sanitary landfills (Section 4004), to facilitate the closing or upgrading of existing open dumps (Section 4005), and to provide assistance for these activities to rural communities (Section 4009). HSWA directed EPA to survey solid waste management facilities across the Nation and evaluate whether current guidelines and standards are adequate to protect human health and the environment, as well as to revise the landfill guidelines.

RCRA also contains *a substantial research, development, demonstration and information subtitle* (Subchapter VIII). In addition to establishing broad research authorities for EPA, alone or after consultation with the Secretary of Energy (Section 8001), this subtitle identifies special studies to be supported (e.g., on glass, plastics, tires, waste composition, small-scale technology, and source separation) (Section 8002). Section 8003 identifies a comprehensive list of topics for which the EPA is to "develop, collect, evaluate and coordinate information." This includes information on methods to reduce the amount of solid waste generated, the availability of markets for energy and materials recovered, methods and costs of collection and management practices, and research and development projects for solid waste management.

A central reference library was to be established and maintained to house this information and other relevant data on the performance and cost effectiveness of various waste management and resource conservation technologies and systems (Section 8003(b)). *Full-scale demonstration facilities and grants* for resource recovery systems and "improved solid waste disposal facilities" programs also were to be established (Sections 8004-8006).

Procurement guidelines were to be prepared by the EPA, after consultation with the Administrator of General Services, the Secretary of Commerce, and the Public Printer (RCRA, Subchapter IV). The guidelines should designate items produced with recovered materials that must be procured by Federal agencies; recommend practices for the procurement and certification of such items; and provide information on the availibility, relative price, and performance of such items (Section 6002(e)). EPA was required to prepare guidelines for paper and three other product categories, including tires, by 1985. In addition, each procuring Federal agency is required to establish a procurement program (Section 6002(i)).

In addition to EPA, the other Federal agency given major responsibilities under RCRA is the Department of Commerce (Subchapter V). Four special areas of responsibilities are delineated: 1) to develop accurate specifications for recovered materials; 2) to stimulate and develop markets for recovered materials; 3) to evaluate and promote proven energy and materials recovery technologies; and 4) to establish a forum for the exchange of technical and economic data relating to resource recovery facilities (Sections 5001-5005).

[1]P.L. 94-580 (1976). Congress first established a Federal role in solid waste issues in the Solid Waste Disposal Act of 1965 (P.L. 89-272; as amended by the Resource Recovery Act of 1970, P.L. 91-512). RCRA was revised most recently by the Hazardous and Solid Waste Amendments of 1984 (P.L. 98-616) and is in the process of further revision and reauthorization.

[2]Subtitle D also addresses other facilities, including nonhazardous industrial waste landfills, land application units, and surface impoundments.

Box 1-C—EPA'S AGENDA FOR ACTION

EPA's report, "The Solid Waste Dilemma: An Agenda for Action," concluded that "to the extent practical, source reduction and then recycling are the preferred options for closing the gap [between waste generation and management capacity] and reducing the amount and toxicity of waste that must be landfilled or combusted" (EPA, 1989). In the report, EPA set a national goal of achieving 25 percent source reduction and recycling by 1992, and estimated that incineration would handle about 20 percent and landfilling about 55 percent of MSW at that time. EPA also developed specific objectives and outlined its future activities, as briefly described here:

Increase Information
- develop educational and technical materials
- sponsor national conference on research and development
- establish a clearinghouse for information
- establish a peer matching program

Encourage Increased Planning
- help States develop strategies (workshops, selected State plan reviews)

Encourage Increased Source Reduction Activities
- promote toxicity reduction (e.g., studies, testing guidelines, options regarding lead and cadmium)
- promote quantity reduction (studies, corporate recognition, workshops)
- procurement of products with source reduction attributes
- study source reduction policies

Participate In and Encourage Increased Recycling
- stimulate markets (e.g., studies on markets and incentives, guidelines for composting, Federal Task Group for implementing procurement)
- promote better separation and processing (model training and education programs, options for batteries and appliances, interagency work group)
- facilitate formation of a national advisory council
- review hazardous waste liability issue

Help Reduce the Risks of Combustion
- upgrade combustor performance standards and ash management
- decide whether to develop model operator certification program
- provide information on problem wastes

Help Reduce the Risks of Landfilling
- operator certification (training, State certification guidance)
- issue final criteria on design and operation
- technical guidance on revised criteria
- provide information on problem wastes

Box 1-D—THE MSW "SYSTEM"

The "system" that produces MSW is complex and dynamic, and different parts of it are linked together in ways that are not always clear. Illustrating the elements of the system can help identify leverage points at which strategies can be developed and options applied most effectively.

1) Materials/products lifecycle
   - products: design, production, distribution, purchase, use, discard
   - non-product materials (yard and food waste): generation, discard
   - management: collection, processing, treatment/disposal

2) Actors that touch materials and products
   - designers, manufacturers, distributors, retailers
   - waste managers (haulers, landfills, incinerators, recyclers)
   - citizens (purchase, generation, siting decisions)

3) Private infrastructure
   - collection system, reclamation/other processing (e.g., scrap industry)
   - landfills, incinerators, recycling facilities
   - structure of waste management industry
   - structure and dynamics of materials industries
     - — dynamics of prices and disposal costs
     - — international aspects
   - financial sector

4) Public institutional structure
   - local decisionmaking and infrastructure
   - collection programs, reclamation/other processing
   - landfills, incinerators, recycling facilities
   - government programs
     - — dynamics of Federal & State roles and plans
     - — subsidies and incentives (e.g., PURPA, tax credits)
     - — effects on private sector

5) Social attitudes
   - value judgments
     - — about environmental protection and health effects
     - — about product design and consumption
   - resource policies
     - — extent to which Federal government involved
     - — how the Nation deals with materials and energy policies
   - siting of facilities, degree of acceptable risks
   - economic factors (e.g., internalizing costs)

Box 1-E—GENERAL MARKET FACTORS

Recycling—despite its promise as an important element in a MSW prevention and management strategy—has two important caveats that policymakers should consider. First, policymakers should be aware of the distinction between supply-limited and demand-limited materials. Second, they should be aware that market prices for secondary materials can fluctuate dramatically. In addressing the first issue, Federal activities should be flexible to distinguish between materials that are not being recycled at a high level because they are either supply-limited (i.e, are not collected in sufficient amounts or are too highly contaminated for current manufacturing processes) or *demand-limited* (i.e., buyers are relatively scarce even though supplies may be available). This distinction matters from a Federal perspective because some options may be ineffective if applied indiscriminately to all types of materials. The distinction generally does not apply to the private sector because from that perspective the market sets the prices required to bring forth needed supplies. The market does not assure that all sources of supply are being tapped, however. In this case, for example, a valuable source of supply of raw materials exists in MSW, but the potential supplier (i.e., waste generator) is not always aware of the value of those materials.

These distinctions also are time-dependent. Markets are constantly in flux, and a material now in short supply could be in oversupply at a later date. Materials in MSW considered as supply-limited in 1989 include old corrugated containers, office papers, single-resin plastics, glass, tin cans, and aluminum. Demand-limited materials include old newspapers, mixed papers, mixed plastics, used oil, tires, compost, and ferrous scrap other than tin cans.

Second, the 1988-89 market environment has some materials priced at or near their peak levels. Given the history of fluctuation in most materials markets, recycling decisions should not be made only on the basis of current prices. Of course, markets will always exist for most materials. The question is: where will contractions in the system occur when demand declines? The existing private infrastructure has substantially increased collection rates for many materials (e.g., aluminum, glass, and paper). However, increased municipal collection of MSW provides a supply of materials that is not sensitive to demand. In some cases, these materials will be made available even at negative prices because municipalities can afford to pay manufacturers to take collected materials as long as the fee is less than disposal would cost. As a result, private sector suppliers are likely to be less competitive and to constitute "marginal" supply sources during times of declining demand to a wider extent than ever before. Efforts to manipulate markets, therefore, must consider potential effects on employment and tax revenue generated by private sector suppliers.

Box 1-F—MARKETS FOR RECYCLED MATERIALS

About 10 percent of MSW was recycled in 1986 (Franklin, 1988). Although this figure may seem small, it masks a great deal of activity in the recycling arena. In fact, by some estimates, recycling rates may be higher than those estimated by Franklin for particular materials (fig. 6). For most materials, many opportunities exist to increase materials recovery from MSW, both in the short and longer terms. The state of the economy, both nationally and globally, will play a large role in determining whether these opportunities will be realized.

Recycling is the management alternative that traditionally goes the farthest beyond the Federal government's purview. Carefully tailored policy options may help stimulate these markets, but blanket policies that address all materials equally may be ineffective and, even worse, wasteful.

Aluminum constitutes only 1 percent of MSW, but it has a recycling rate of between 25 percent and 45 percent. Aluminum cans, almost 80 percent of all aluminum in MSW, are recycled at a 55 percent rate. The technology and economic incentives exist to enable a significant increase in this recovery rate. The major barrier is the inadequacy of the collection process.

Paper and paperboard, comprising 41 percent of total MSW discards, are recovered from MSW at a rate of 22 percent to 28 percent. Some short-term opportunities exist to increase this rate, particularly for tissue, newsprint, and linerboard, but technical and capacity barriers may delay more dramatic increases.

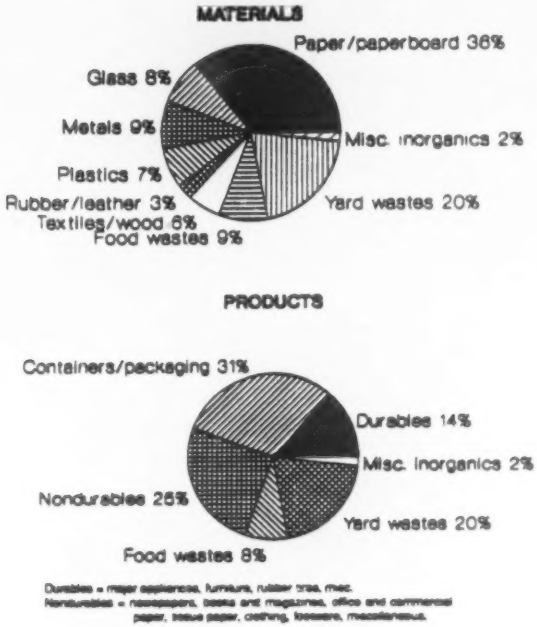
Glass, mostly containers, accounts for about 8 percent of MSW and is recovered at a rate of 10 percent to 15 percent. The glass industry is actively expanding processing capacity for post-consumer glass (known as cullet), which in many cases can reduce the cost of producing glass containers. Technically, when colors are separated, 100 percent cullet can be used in making new containers, considerably more than the current industry average of 25 percent (which includes industrial scrap).

Iron and steel account for about 7 percent of MSW and are recovered at a rate of 4 percent to 20 percent. Some potential exists for increased recycling of steel cans, which account for about one-third of ferrous scrap. Recent increases in detinning capacity will improve the recycling rate for "tin" food cans, and major steel mills are gearing up to increase consumption of bimetal (steel and aluminum) beverage cans. Recovery of other ferrous scrap is not likely to expand significantly, because supply from other sources is abundant and growth in demand is limited.

Plastics, which make up about 7 percent by weight of MSW, have the lowest recovery rate among MSW components—only about 1 percent. Recycling of post-consumer plastics is in its infancy, with most efforts focussed on two resins (PET and HDPE). However, considerable market potential exists for increased recycling of these and other resins. The plastics industry also is making a major effort to develop recycling collection/processing systems.

Yard and food waste is an important part—about one-fourth—of MSW, but only negligible amounts of these materials are composted. However, composting is now receiving considerable attention, and a number of localities are considering it as an alternative to incineration or landfilling. Marketability will be determined largely by the quality of compost.

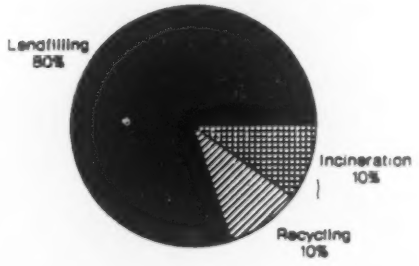
Figure 1—Estimated Portions of Materials and Products in MSW, 1986, by Weight



Durables = major appliances, furniture, rubber tires, misc.
Nondurables = newspapers, books and magazines, office and commercial paper, tissue paper, clothing, footwear, miscellaneous.

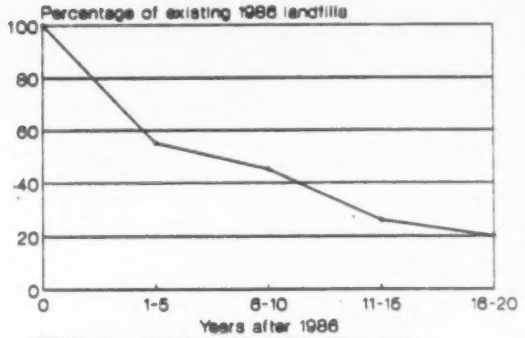
SOURCE: Franklin Associates(1988)

Figure 2—Use of Management Methods



SOURCE After Franklin (1988)

Figure 3—Estimated Decline in Existing Permitted Landfills



NOTE Based on estimate of 6,034 landfills; data for years 1-5 include an estimated 535 closings in 1986-87.

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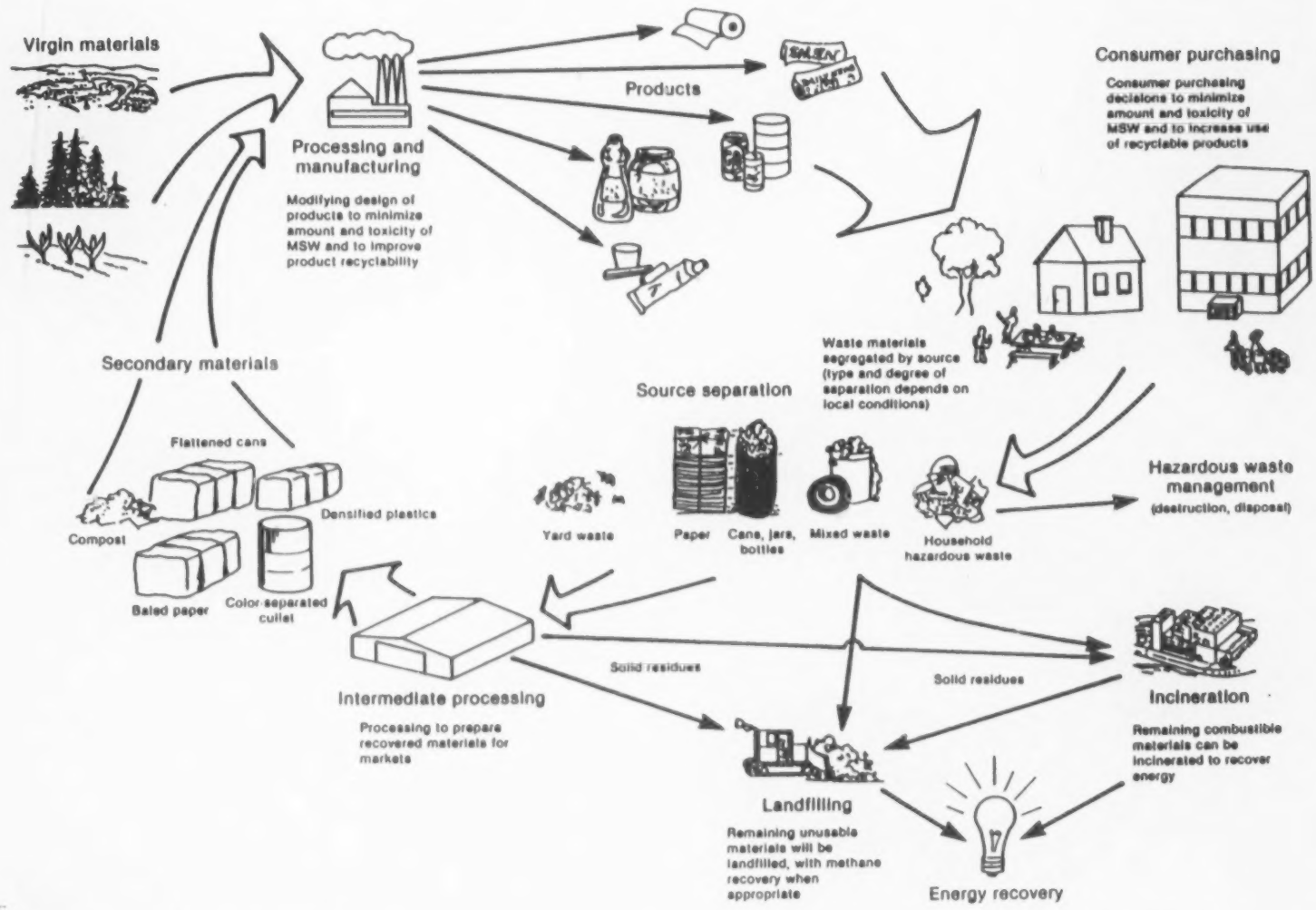
Figure 4.—Waste Prevention and Materials Management Approach

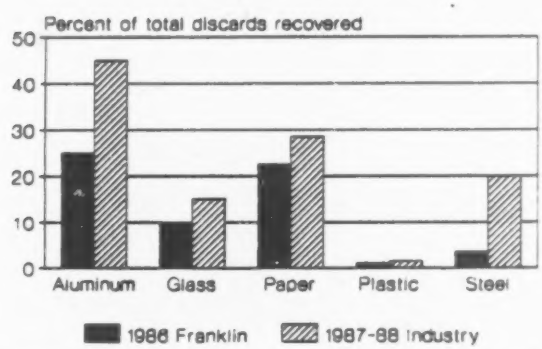

Virgin materials
Processing and manufacturing
Modifying design of products to minimize amount and toxicity of MSW and to improve product recyclability
Products
Consumer purchasing
Consumer purchasing decisions to minimize amount and toxicity of MSW and to increase use of recyclable products
Secondary materials
Waste materials segregated by source (type and degree of separation depends on local conditions)
Source separation
Flattened cans
Densified plastics
Compost
Baled paper
Color-separated cullet
Yard waste
Paper
Cans, jars, bottles
Mixed waste
Household hazardous waste
Hazardous waste management
(destruction, disposal)
Solid residues
Solid residues
Intermediate processing
Processing to prepare recovered materials for markets
Incineration
Remaining combustible materials can be incinerated to recover energy
Landfilling
Remaining unusable materials will be landfilled, with methane recovery when appropriate
Energy recovery

SOURCE: Office of Technology Assessment, 1989

Figure 5—The "Environmental Angel" Logo

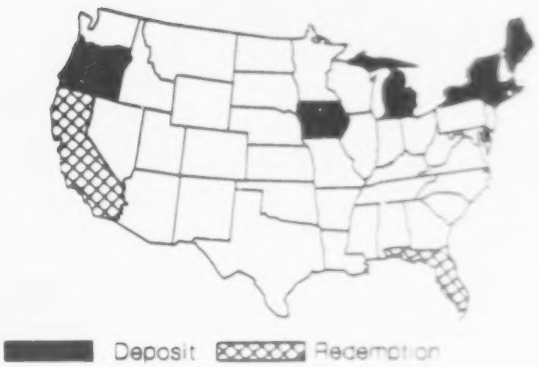
SOURCE: Deutsches Institute fur Guteseicherung und Kennzeichnung E.V. (July 1988)

Figure 6—MSW Recycling Rates: Franklin v. Industry Estimates



SOURCE: Franklin (1988), Aluminum Association (1989), Copperthite (1989), API (1988), SPI (1988), Steel Can Recycling Institute (1989).

Figure 7—States With Deposit or Redemption Systems



SOURCE: OTA

Table 1-1—Potential Policy Options and Activities for MSW

Category	Issue	Option
Enhance Institutional Framework	Integration: Planning and Coordination	Require State MSW Management Plans Improve Interagency Coordination
	Ensuring Capacity: Siting, Interstate Transportation	Allow Barriers to be Imposed on MSW Imports Require States to Ensure Adequate Management Capacity Develop Model Siting Procedures
	Enforcement	Define Stronger Role for EPA in Enforcement
	Improving Flow of Information	Information Clearinghouse Education Increase Federal Research
	Funding	Product Fees User or Waste-End Fee National Income Tax
Waste Prevention	Developing National Goals and Assuring Them High Priority	Goals to Reduce Quantity Goals to Reduce Toxicity Assure High Priority in Federal Agencies
	Providing Economic and Other Incentives	Grant Fund High-Visibility Awards Federal Procurement
	Improving Information Flow	Develop Labeling With Reduction Information Data on MSW Generation
	Banning Specific Products and Substances	Ban
Recycling	Increasing Information and Education	Improve Collection, Dissemination of Information Increase Education Awards for Product Design and Labeling
	Research and Development	Funding for Research
	Standardized Definitions, Labeling, and Avoided Cost Calculations	Standardize Definitions and Testing Procedures Standardize Guidelines for Labeling Standardize Avoided Cost Calculations
	Regulations for Recycling Facilities	Ensure Adequate Regulation of Recycling Facilities Resolve Conflicts with Hazardous Waste Regulations
	Market Development	Procurement Programs Direct Subsidies Economic Development Building Export Markets
	Fees and Pricing Policies	Rate of Progress Fees on Manufacturers Increase Cost of Alternatives Product Charges
	Requiring Secondary Materials Recovery and Reprocessing	Deposit Legislation Require Use of Secondary Materials Require Source Separation Programs Bans National Stockpile of Secondary Materials
Incineration	Clarifying Ash Management	Clarify Household Waste Exclusion Decide How to Manage Ash Under Subtitle D
	Clarifying Emissions Regulation	Choose Standards Based on BACT or on Risks Establish Policies Regarding Existing Facilities
Landfills	Giving Additional Direction to EPA's Regulatory Effort	Specify How Landfills Should be Regulated Extend Corrective Action and Closure Requirements
	Clarifying Liability Provisions	Clarify Superfund Listing Policy